Thames Water

Affinity Water
Taking care of your water

WATER for LIFE from Southern Water

South East Strategic Reservoir Option (SESRO)

Supporting Document B

Drinking Water Quality Risk Assessment (DWQRA) Report

J696-DN-A01A-ZZZZ-RP-PE-100001

Version: 1.0

Standard Gate three submission for SESRO

SRO

Notice – Position Statement

- This document has been produced as the part of the process set out by RAPID for the development of the Strategic Resource Options (SROs). This is a regulatory gated process allowing there to be control and appropriate scrutiny on the activities that are undertaken by the water companies to investigate and develop efficient solutions on behalf of customers to meet future drought resilience challenges.
- This report forms part of the suite of documents that make up the 'Gate 3 submission.' Gate 3 of the RAPID programme represents a checkpoint on the way to solutions being prepared for consent applications. The intention at this stage is to provide RAPID with an update on activities being undertaken in preparation for consent application submission; activities' progress including programme through to completion; and consideration of specific activities to address particular risks or issues associated with a solution. The regulatory gated process does not form part of the consenting process and will not determine whether an SRO is granted planning consent.
- Given the stage of the SROs in the planning process, the information presented in the Gate 3 submission includes material or data which is still in the course of completion, pending further engagement, consultation, design development and technical / environmental assessment. Final proposals will be presented as part of consent applications in due course.
- The project information captured in this document reflects a design freeze in October 2024 following the non-statutory consultation, to meet the requirements of RAPID's gated process. Since then, the design has continued to evolve which includes further work with Affinity Water and Southern Water partners to form agreed requirements for the development consent application, such as the incorporation of Southern Water's proposed water treatment works into the SESRO consent. You can find the latest information about the design and development of the project at https://thames-sro.co.uk/projects/sesro/.

Disclaimer

This document has been written in line with the requirements of the RAPID Gate 3 Guidance (v3, January 2024) and to comply with the regulatory process pursuant to Thames Water's, Southern Water's and Affinity Water's statutory duties. The information presented relates to material or data which is still in the course of completion. Should the solution presented in this document be taken forward, the co-sponsors will be subject to the statutory duties pursuant to the necessary consenting process, including environmental assessment and consultation as required. This document should be read with those duties in mind.

Revision history

Version	Date	Submitted at
1.0	21-07-2025	RAPID submission

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Glossary

Abbreviation	Definition
ACWG	All Company Working Group
AFW	Affinity Water
DCO	Development Consent Order
DWI	Drinking Water Inspectorate
DWQRA	Drinking water quality risk assessment
DWSP	Drinking water safety plan
EA	Environment Agency
IL	Information Letter
INNS	Invasive non-native species
MIB	Methylisoborneol
NDMA	N-Nitrosodimethylamine
PCV	Prescribed concentration or value
PFAS	Poly and perfluorinated alkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulphonate
RAPID	Regulator's Alliance for Progressing Infrastructure Development
SESRO	South East Strategic Reservoir Option
SRO	Strategic Resource Option
STT	Severn to Thames Transfer
SW	Southern Water
SWOX	Swindon and Oxfordshire
TOC	Total organic carbon
T2ST	Thames to Southern Transfer
TW	Thames Water
UV	Ultraviolet
WHO GDWQ	World Health Organisation Guidelines for Drinking Water Quality
WQRA	Water quality risk assessment
WRSE	Water Resources South East
WTW	Water treatment works

1 Executive Summary

Overview

1.1.1 The Drinking Water Quality Risk Assessment (DWQRA) is a supporting document that accompanies the gate three submission report, to the Regulator's Alliance for Progressing Infrastructure Development (RAPID), for the South East Strategic Reservoir Option (SESRO) Strategic Resource Option (SRO).

1.1.2 The DWQRA outlines the water quality risks and considerations for the Strategic Resource Option (SRO), which involves the construction of a new reservoir for public water supply. SESRO involves the abstraction of water from the River Thames during periods of high flow. Flows will be returned to augment the River Thames during periods of drought, through abstraction from SESRO. Direct transfers from SESRO into interconnecting SROs (Thames to Southern Transfer (T2ST)) have also been incorporated, as part of the design, and therefore have been assessed.

1.1.3 The DWQRA has been carried out according to the All Company Working Group (ACWG) guidance developed in the ACWG Water Quality Risk Framework Report[1] as described in section 3, in the format of a Drinking Water Safety Plan (DWSP). The DWQRA assesses limiting hazards, which are defined as any water quality parameter that is likely to drive the development of the SRO proposed. Risk scores were attributed to each limiting hazard, at all stages from abstraction at the River Thames to raw water storage at the reservoir, for each transfer option. These risk scores were captured on dedicated, ACWG-approved spreadsheet water quality risk assessment (WQRA) tools and reviewed in a collaborative strategic WQRA workshop.

1.1.4 The WQRAs included limiting hazards from the following groups and any additional limiting hazards identified during the workshop. A complete list of the limiting hazards identified is specified in Table 3.4.

- Pathogens
- Acceptability due to change in chemistry
- Acceptability due to taste and odour
- Pesticides
- Emerging hazards (including poly and perfluorinated alkyl substances (PFAS))
- Disinfection by-product formation
- Change in metal types and forms
- Nitrate/nitrite

[1] B19589BJ-DOC-001 Rev 06 ACWG WQ Risk Framework Report – Final (Strategic WQ Risk Framework FINAL Report) | 19/01/21 | ACWG

1.1.5 Throughout the DWQRA process, the list of limiting hazards for each option was reviewed and refined to give a representative, high-level view of the parameters which are likely to need treatment further down the "source to tap" pathway.

Water Quality Risk Assessment

1.1.6 Results from the gate three water quality risk assessments continue to inform the engineering concept design of this option at this stage. Gate two workshop outcomes have been incorporated into the gate three DWQRA process. Newly available monitoring data and emerging hazard guidance, from the DWI and ACWG, have continued to inform and develop the DWQRAs.

1.1.7 Two DWQRAs have been produced for each of the transfer options: augmenting River Thames flows in periods of low flow, and a direct raw transfer to the T2ST SRO. The water quality risk assessment workshop conclusions are detailed in Section 5.0. Some key DWQRA outcomes across both transfer options are summarised below:

- Pathogen risk remains high as identified in Gate 2. Further water quality data including the presence of E.coli, coliforms and somatic coliphages point out faecal and sewage contamination in the River Thames.
- Monitoring and modelling of the River Thames and SESRO reservoir indicate large populations of algae in the River Thames. Algal populations decrease as nutrient concentrations decrease in the reservoir due to biological activity. The presence of algae subsequently increases when abstraction resumes from the River Thames.
- Emerging hazards – Perfluorinated alkyl substances (PFAS) risk remains high, current catchment data indicates Tier 2 classification according to Drinking Water Inspectorate (DWI) 2 guidance.
- Emerging hazards - chromium risk currently low according to data from the monitoring programme to date.
- Customer acceptability risks due to changing source are low for SESRO, however integration with downstream SROs (particularly T2ST) need to consider impact of SESRO on their distribution networks.

1.1.8 Control measures identified in the DWQRA process include reservoir management controls (mixing, aeration, intake depths, inlet intake screens for Invasive Non-Native Species (INSS) etc.). Water quality monitoring of the River Thames and SESRO reservoir will also greatly mitigate risks by informing when abstraction is suitable and

[2] Guidance on the Water Supply (Water Quality) Regulations 2016 (as amended) for England and Water Supply (Water Quality) Regulations 2018 for Wales specific to PFAS (per- and polyfluoroalkyl substances) in drinking water | August 2024 | Drinking Water Inspectorate

notify of any potential pollution events.

Future Work and Recommendations

1.1.9 The results of the gate three DWQRA process have highlighted the following recommendations for future work:

- Review the plans to relocate one of the existing outfalls from the Abingdon Sewage Treatment Works, ensuring there is sufficient distance between the new location and the SESRO intake from the River Thames.
- Understand operational controls on potential recreation activities at the reservoir to ensure appropriate mitigations are put in place.
- Continue and where applicable, enhance the water quality monitoring program to gather a broader set of quantitative data, particularly for emerging contaminants, to better inform risk likelihood scores and identify any seasonal patterns.
- Continue to monitor parameters for which regulatory enforcements may change or come into effect e.g. PFAS, chromium, endocrine disrupting compounds, NDMA.
- Integrate WQRA spreadsheets with downstream stages of the “source to tap” pathway for linked SROs and possible future connections into SESRO.
- Continue to plan customer engagement about the scheme’s acceptability, particularly in cases where changing the water source might affect customer acceptability due to aesthetic qualities such as colour, taste, and odour.

2 Introduction and Context

2.1 Introduction

2.1.1 Under the Water Industry Act 1991, every water company must prepare and maintain a Water Resources Management Plan (WRMP). This plan is updated every five years and sets out how companies are required to produce WRMPs every five years. The water-stressed status of south-east England was recognised by Ofwat (the Water Services Regulation Authority) following submission of the WRMP 2019 (Various Water Companies, 2019), and subsequently, funding was provided for water companies to investigate, then develop SROs that will benefit customers and the wider society and help protect and enhance the environment. Thames Water's WRMP 2024 was published on 18 October 2024, following a direction to publish from the Secretary of State in August 2024. The WRMP24 aligns with the revised draft Water Resources South East (WRSE) regional plan and establishes the need for a new 150Mm3 reservoir (the South East Strategic Reservoir Option, or SESRO) that will primarily supply Thames Water, Southern Water and Affinity Water customers.

2.2 SESRO

2.2.1 In 2019, Ofwat provided funding for water companies to investigate and develop new large scale Strategic Resource Options (SROs) which are expected to play a crucial role in meeting long-term water needs, particularly in the south east which is described as "seriously water stressed". SESRO is a strategically important SRO which requires development by multiple partners for wider regional benefit beyond one company's supply boundaries. This type of scheme is lengthy and complex to consent and develop. In accordance with Thames Water's WRMP, SESRO is required to be operational by 2040.

2.3 RAPID

2.3.1 RAPID, a joint team made up of the three water regulators: Ofwat, the Environment Agency (EA) and the Drinking Water Inspectorate (DWI), was set up to support and oversee the progress of SROs. At PR19, Ofwat introduced a new gated process for which RAPID provides advisory oversight. At each gate, RAPID assesses the progress made in the development of each solution and provides recommendations to Ofwat on whether to release the next tranche of funding to continue scheme development. This process allows comparison of the solutions at regular intervals, and has clear checkpoints, or 'gates', to assess progress and determine which solutions should be taken forward for further work.

2.3.2 Each scheme passes through a series of governance 'gates', enabling key information to be presented and an assessment made on whether the scheme should continue for further development. The gates, for a standard SRO, set out by Ofwat in PR19 are as follows:

- Gate 1 – Initial feasibility, design and multi-solution decision making.
- Gate 2 – Detailed feasibility, design and multi-solution decision making.
- Gate 3 – Finalised feasibility, pre-planning investigations and planning applications
- Gate 4 – Planning application, procurement strategy and land purchase.

2.4 Structure of Report

2.4.1 This report has been prepared to provide technical supporting information for the SESRO SRO gate three submission to RAPID. This report is Supporting Document B Drinking Water Quality Risk Assessment (DWQRA) Report. An overview of the SESRO project is provided in the gate three main report to RAPID (primarily, in section 2).

2.4.2 The structure of this supporting document is as follows:

- Section 1 – Gives and introduction and provides context, scope and assumptions;
- Section 2 – Describes the methodology used in assessing drinking water quality risk;
- Section 3 – Provides the results of the work that has been undertaken for gate three;
- Section 5 – Discusses the results; and
- Section 6 – Provides recommendations for future work.

2.5 Scope

2.5.1 This report covers the drinking water quality considerations for a new 150Mm3 reservoir (SESRO) that will primarily supply Thames Water, Affinity Water and Southern Water. Southern Water will be served through a transfer connection to the proposed Thames to Southern Transfer (T2ST) WTW. Essex and Suffolk Water could also be served by onward transfer via Chigwell WTW from Lower Hall pumps station (raw transfer). All other companies will benefit from a take and put option to the River Thames. There is potential to serve South East Water through an existing abstraction on the River Thames. SESRO's interconnections and transfers are described below:

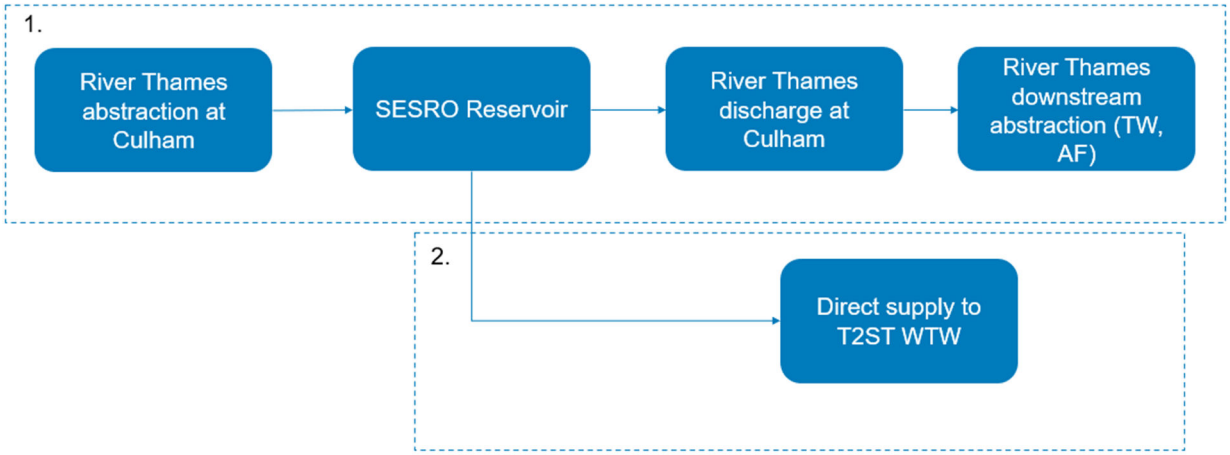
- Option 1- A put and take option pumping a peak of 1,200Ml/d into the reservoir including return flows from T2ST, and potentially enabling flows of up to 500Ml/d into the reservoir from potential Severn to Thames Transfer (STT) project in the future. Discharging normal flows of up to 321Ml/d to the river (peak flow of 600Ml/d).
- Option 2 – This option includes a transfer of 120Ml/d to the Thames to Southern Transfer SRO (T2ST) to Southern Water Hampshire water resources zone. This option includes return flows from T2ST WTW into the reservoir when necessary, during commissioning and where potable water cannot be put into supply.
- Option 3 – This option requires a raw transfer of 24Ml/d for Farmoor to the existing Farmoor reservoir and treated at Farmoor WTW with scope for expansion of up to 150Ml/d for the Farmoor transfer project serving SWOX. This is to support as future abstraction reductions are enforced at Farmoor.

- Option 4 - The SESRO design will allow for the capability to add a treated water transfer to SWOX zone of up to 72Ml/d in the future.

2.5.2 The purpose of this report is to summarise the gate three Drinking Water Quality Risk Assessment (DWQRA) process from methodology through to results for transfer Option 1 and Option 2.

2.5.3 Figure 2.1 shows an overview of the transfer options 1 and 2 that form part of the two DWQRAs produced for the purposes of the workshop.

Figure 2.1 SESRO Gate Three Schematic



Source: Mott MacDonald – SESRO schematic

2.6 Key factors and assumptions at Gate Three

The following assumptions were made when completing the DWQRAs and subsequent DWSPs:

- Interaction with the River Thames: Option 1 involves the augmentation of flows of the River Thames during drought periods. It is assumed that the bulk of the flows from the River Thames continue to be natural river flows. The discharge of water from SESRO into the River Thames is expected to have a minimal (or no) impact on water quality, with the exception of algae which may be impacted by the reservoir. This is attributed to the original water source for the SESRO reservoir to come from the River Thames.
- Residence time in the reservoir: SESRO is designed for a long water retention time of 7 years and due to its size and design, it is expected that there will be changes in water quality (caused by mixing, sedimentation, biological activity etc.). The retention time in the reservoir is largely impacted by the hydrological conditions and flows in the River Thames.
- No secondary water sources: For the purposes of this assessment, it has been assumed that there is no direct connection into the reservoir where new water will be introduced. Water will continue to be sourced from the River Thames, and impacts from the Severn

to Thames Transfer (STT) interconnector on water quality have not been included in these assessments.

- T2ST connection: It is assumed the risk scores from the SESRO reservoir stage of the assessment are incorporated within T2ST DWQRA.
- Downstream interconnections: Includes both the Farmoor and SWOX connection. At the time of the assessment connections were not finalised. It is assumed the risk scores from the SESRO reservoir stage of the assessment are to be incorporated within SWOX DWQRA. Once Farmoor connection is further developed, a DWQRA including SESRO as a water source will need to be completed.

2.6.1 The following report details the gate three DWQRA methodology, the water quality data collected, the water quality hazards investigated, the WQRA workshop discussion results and the future DWQRA work plan. The DWQRAs produced as part of the gate three RAPID submission align with the All Company Working Group (ACWG) Risk Framework[3] methodology, the RAPID gate three guidance[4] and the RAPID gate three submission template[5]. The DWQRA methodology outlined in this report is designed to be aligned with regulation 15[6] and regulation 27[7] which requires water companies to carry out a risk assessment of treatment works including water source and catchment. As SESRO encompasses a reservoir but no treatment works within its concept design, the assessment has been carried out for the catchment and reservoir, with consideration for impacts of connecting downstream water treatment processes as described in option 1 and option 2.

2.6.2 A WQRA workshop was carried out for each transfer option, where draft water quality risk scores for water quality hazards relevant to the scheme were discussed. The outcomes of these workshops are detailed in Section 5.3.1 and Appendix A and the full results of the workshops are in Appendix 1.

2.6.3 Consideration of regulation 31 has been incorporated in the DWQRA assessment of SESRO. As there are no potable elements within the SESRO boundary, no assets have been identified at this stage as requiring compliance with regulation 31.

[3] B19589BJ-DOC-001 Rev 06 ACWG WQ Risk Framework Report – Final (Strategic WQ Risk Framework FINAL Report) | 19/01/21 | ACWG

[4] Strategic regional water resource solutions guidance for gate three | Regulators' Alliance for Progressing Infrastructure Development | January 2024 | Ofwat

[5] RAPID - Gate three submission template | January 2024 | RAPID

[6] Regulation 15: Sampling: new sources | April 2020 | DWI

[7] Regulation 27: Risk assessment | April 2020 | DWI

3 Methodology

3.1 DWQRA process

3.1.1 The DWQRA process has been developed by the All Company Working Group (ACWG) as a strategic semi-quantitative water quality risk assessment from source to consumer to determine the impact of new SRO schemes on drinking water quality.

3.1.2 For this SRO, two WQRAs have been completed to assess the water quality risks of abstracting water from the River Thames and storing it in a reservoir, to subsequently release back in to the River Thames during periods of drought, or through a raw water connection in to downstream SROs.

3.1.3 These risk assessments will help inform the design and development of the options and ensure no deterioration in the water quality of the associated supply zones. The WQRAs have been undertaken using current knowledge of water quality and the judgement of water company experts who are familiar with the sources and supply zones. The DWQRA process will continue to feed into the design process as the SRO development continues.

3.1.4 The ACWG Water Quality Risk Framework Report[8] has been used to guide the risk assessment and splits the DWQRA process into 5 stages, as seen in Figure 3.1.

Figure 3.1 ACWG water quality risk process approach

Source: ACWG WQ Risk Framework Report

3.1.5 For gate three, data relevant to the SRO was collected from various sources, including water quality monitoring from a targeted cross-SRO monitoring programme at the intake location, as well as Thames Water monitoring and DWSPs near the intake location and downstream from the discharge location. Affinity Water DWSPs and EA publicly available data near the abstraction location and downstream of the discharge along the River Thames were also incorporated in the strategic drafting of the WQRA.

[8] B19589BJ-DOC-001 Rev 06 ACWG WQ Risk Framework Report – Final (Strategic WQ Risk Framework FINAL Report) | 19/01/21 | ACWG

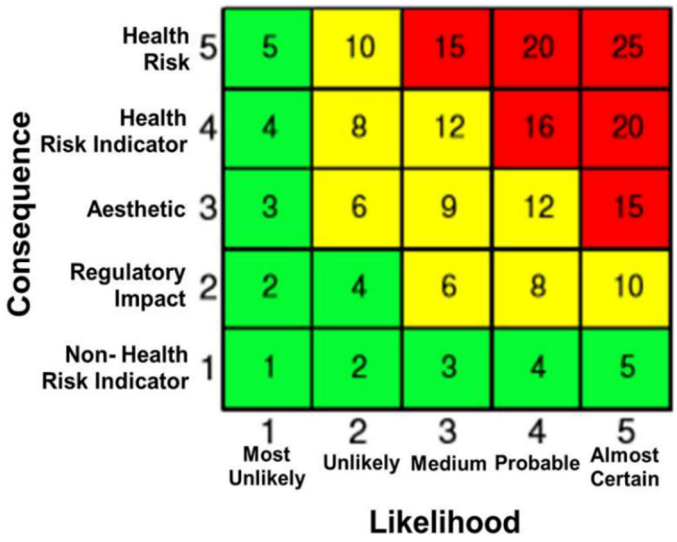
3.2 Application to the scheme

3.2.1 The process of undertaking the steps outlined in **Figure 3.1.** is detailed in sections 3.3 - 3.8. The steps taken to complete the SESRO WQRAs were guided and organised by the responsible lead technical author, Mott MacDonald. As suggested in the ACWG WQ Risk Framework Report, this party is responsible for collating and analysing water quality data to provide initial drafts of the WQRA spreadsheet tool for each of the SRO options. This party is also responsible for convening the strategic water quality risk assessment workshop to review and develop the risk assessments. This review must be completed to the agreement of all water companies affected by the SRO. The framework states a WQRA should be completed for each materially different option at each RAPID stage gate, with the resulting risk assessment remaining a live document to eventually be developed in the style of a drinking water safety plan (DWSP) in line with DWI requirements and RAPID guidance[9] for gate three. The ACWG-approved WQRA risk assessment tool is constructed in similar fashion to DWSPs. This will allow conversion of risk analyses for all parameters studied in the RAPID gated process into DWSP format when the
project is at a sufficiently advanced stage.

3.2.2 The ACWG Water Quality Risk Framework report provides guidance for completing the assessment of water quality risks based on existing water company risk assessment techniques. This has allowed for an easier integration of existing risk assessment data into the WQRAs. For example, the approach outlined adopts a 5 x 5 matrix of hazard likelihoods and consequences, seen in Figure 3.2 that aligns with the scoring system typically used by water companies.

[9] Strategic regional water resource solutions guidance for gate three | Regulators' Alliance for Progressing Infrastructure Development | April 2023 | Ofwat

Figure 3.2 WQ Risk framework 5x5 matrix



Source: ACWG WQ Risk Framework Report

3.2.3 A key consideration in the methodology recommends focussing on only the limiting hazards likely to affect the development of an option design. These limiting hazards are defined within the WQ Framework as:

"*Hazards and hazardous events which are most likely to drive the development and/or acceptability and/or viability of the SRO or water supply scheme*"

3.2.4 This definition has been produced in recognition of the need to complete a strategic, high level WQRA appropriate for the conceptual development of the SRO. As there are numerous waterborne pathogens and chemicals that could affect drinking water wholesomeness, as defined in the Water Supply (Water Quality) Regulations 2018[10] (WSR2018), the practical suggestion is to consider the few that are limiting. That is, where the magnitude of risks and their required mitigation determines the design of treatment. This allows for a more focussed assessment of risks, better aligned with the design development and data types and availability at early stages of RAPID gated analysis.

3.2.5 The methodology undertaken for this SRO follows the approach set out in the ACWG WQ Framework Report. It is anticipated that moving through future gates, the WQRA will continue to follow ACWG methodology as further information becomes available.

3.2.6 To complete the risk assessments, a strategic WQRA spreadsheet tool was used to

[10] The Water Supply (Water Quality) Regulations 2018 | 2018 No.614 | 14/06/18 | UK GOV

capture the risks associated with hazards across multiple stages from catchment through to consumer. Each stage contains a pre-mitigated risk section and post-mitigated risk section, with space for suggested controls, residual risk considerations and actions. The results of these WQRAs can be seen in Appendix A.

3.2.7 The DWQRA process aligns with the considerations discussed in the DWI Long Term Planning Guidance[11] document. The DWI guidance note on long term planning of drinking water supplies provides recommendations and considerations for water companies to ensure the long-term provision of safe drinking water. One of these main recommendations is to conduct comprehensive risk assessments to identify potential hazards that may affect drinking water supplies. This aligns with the process conducted at SESRO Gate 2 DWQRA. Where data was available, the 'top' hazards identified in section 7 of the DWI guidance note were studied in the DWQRA.

3.2.8 The DWQRA process also aligns with the considerations discussed in the EA's Drinking Water Protected Areas (DrWPAs) report[12]. The DrWPA report focuses on the importance of protecting Drinking Water Protected Areas to ensure resilience of water supply to future pressures and climate change. SESRO aims to reduce pressure on the abstractions from the River Thames during severe drought conditions.

3.3 Data collection

3.3.1 Thames Water provided up to date observed raw water quality data for intakes along the River Thames including Datchet Intake, Sunnymeads intake and Lower Thames Reservoir DWSPs to help understand expected water quality behaviour in the reservoir.

3.3.2 Water quality monitoring data has been collected since December 2020 as part of the SESRO project on behalf of Thames Water by Atkins Realis. This monitoring is taking place alongside Thames routine sampling at Thames Water intakes and alongside Environment Agency routine monitoring along the River Thames. The locations relevant to SESRO are described below in Table 3.1.

3.3.3 Additionally, Affinity Water DWSPs for intakes downstream of the abstraction were collated and analysed.

[11] Price review process - Drinking Water Inspectorate (dwi.gov.uk) | accessed May 2023 | Drinking Water Inspectorate

[12] Drinking Water Protected Areas: challenges for the water environment | June 2022 | Environment Agency |

Table 3.1 Monitoring site locations used at gate three

Data collected	Location
Atkins Realis cross-SRO monitoring suite	Culham (Intake/discharge location), Datchet Intake, Sunnymeads Intake and Wraysbury reservoir
Thames Water, water quality monitoring data and DWSPs	Datchet Intake, Wraysbury Reservoir, Queen, Mother reservoir
Affinity Water DWSPs	Walton, Egham, Chertsey, Sunnymeads
EA data	Culham, Egham, Walton, Cookham

Source: Mott MacDonald

3.4 Development of assessment team

3.4.1 The ACWG Risk Framework report states that an assessment team should be convened to include representatives from any water company affected by the SRO. Therefore, staff who provided information during data collection, had experience in water quality risk assessments or were involved in the conceptual design and intended operation of the SRO were invited to participate in reviewing the WQRA. Representatives from the T2ST SRO were also present to ensure alignment of the WQRAs. Appropriate representatives from water quality teams were included in the workshop, as seen in Table 3.2, to ensure their insight was captured.

Table 3.2 Workshop attendees and roles

Organization	Attendee Role
Thames Water	SESRO project Manager
Thames Water	Technical Manager DWSP Catchment and Treatment
Affinity Water	Treatment Strategy Manager
Affinity Water	Water Risk & Resilience Manager
Southern Water	Water Quality Process Scientist
Southern Water	Programme Design Manager
Mott MacDonald	Assistant Process Engineer
Mott MacDonald	Senior Process Engineer
Mott MacDonald	Technical project manager
Atkins Realis	Assistant Process Engineer
Atkins Realis	Chief Engineer

3.5 Engagement liaison to gate three

3.5.1 During the course of the gate three DWQRA process, the engagement activities outlined in Table 3.3 were conducted.

Table 3.3 Engagement at gate three

Activity	Date	Organisations involved	Purpose	Outcomes
Meeting	13/05/2024	Atkins Realis	Discussion of Gate 2 work and assumptions, discussion of connection to T2ST	Agreed to be involved in DWQRA workshop.
Workshop	11/06/2024	MM, TW, AW, SW, Atkins Realis	DWQRA workshop to go over risk scorings and hazards	Agreed to distribute algae and water quality modelling results to MM to finalise risk scoring for reservoir
Water quality modelling meeting	24/06/2024	MM, Atkins Realis	Initial meeting to discuss water quality modelling	Further meeting to discuss results once available
Water quality modelling meeting	29/08/2024	MM, Atkins Realis	Initial review of water quality modelling results	To meet to discuss and further distribute modelling results
Water quality modelling meeting	18/09/2024	MM, Atkins Realis	Final modelling results review	Modelling results issued.
Correspondence with T2ST water quality team	Various	MM, Atkins Realis	Liaison to discuss T2ST progress to ensure alignment between SROs	

3.6 WQRA Draft

Consequence ratings

3.6.1 To ensure consistency across all stages and options in gate three, a list was produced that standardised the consequence ratings of each hazardous parameter. The ratings were based on information sourced from the WHO Guidelines for Drinking Water Quality (WHO GDWQ)[13] and followed the five-by-five risk matrix system of grading consequences.

3.6.2 The ratings were built on the assumption that the hazards were present above the

[13] Guidelines for drinking-water quality: fourth edition incorporating the first addendum | 2017 | Geneva: World Health Organization | Licence: CC BY-NC-SA 3.0 IGO.

limits set by the Water Supply (Water Quality) Regulations 2018 and the effects would therefore range from “non-health risk indicator” to “aesthetic” impacts to “health impacts”. Where no limits were available, the consequence ratings were chosen assuming the hazard was present at a concentration high enough to attain the most severe consequence category possible, as seen in Figure 3.2.

3.6.3 For example, total organic carbon (TOC) has no specific limit in the Water Supply (Water Quality) Regulations other than a requirement for “no abnormal change”, but is an indicator for bacterial growth, and therefore earns a consequence rating of 4. This rating is for health risk indicators, because while TOC does not inherently classify as a ‘health risk’, it also does not cause purely ‘aesthetic’ consequences. The standardised consequence ratings were then input into the WQRA spreadsheet tools.

Likelihood ratings

3.6.4 Following the input of consequence ratings into the WQRAs, the draft likelihood ratings were determined based on the water quality data collected and inputted into the spreadsheets. These ratings were then reviewed by water quality experts in a workshop for each option, as listed in Table 3.2.

3.6.5 For certain parameters where no data was available, but the hazard was deemed limiting, assumptions were made as to likelihoods based on expert opinion. An example of this is the “Taste” parameter that was deemed high risk through the catchment abstraction, stages until the treatment stage, where the likelihood would then decrease post-mitigation as taste issues would be tackled through conventional treatment process. As treatment is not considered as part of the SESRO boundary, these risks should be reflected in subsequent Thames Water DWSPs and Affinity Water DWSPs as well as publicly available EA data at abstractions further downstream of SESRO. Other parameters in the catchment that required expert opinion to score as no data was available included odour, taste, and viruses (excluding somatic coliphages).

3.6.6 For the catchment stage, water quality monitoring data from Thames Water and Atkins Realis were utilised from various points through the catchment and at the proposed abstraction location and expert judgment was used to assess the likelihood of a parameter breaching the Water Supply (Water Quality) Regulations 2018 limits. The likelihood scoring was based on how often the parameter historically breached these regulations on an annual basis as seen in Figure 3.3.

Figure 3.3 Likelihood scoring according to breaches on an annual basis

Level	Likelihood *during SRO operation* – example definitions	Consequence
1	Very unlikely / rare	No impact, >50% PCV, insignificant
2	Unlikely / possibly within 5 years	Low impact, single PCV, DWI event level 1,2, minor compliance
3	Moderate / possibly within 3 years	High impact, multiple PCV, DWI event level 3, aesthetic impact
4	Likely to occur once per year	Serious impact, precautionary advice, DWI event 4, major regulatory
5	Almost certain / Likely to occur > once this year	Major impact, precautionary advice, DWI event 5, water unpotable, health impact

Source: ACWG Strategic WQ Risk Framework

3.6.7 Where relevant, likelihood ratings in the reservoir stage were reduced between pre-mitigation and post-mitigation based on expert opinion, reflecting the effectiveness of proposed control measures on hazard reduction. An assessment of the likelihood scorings was developed at gate two, using these assumptions. These assumptions were also applied during the WQRA drafting stage of gate three, utilising updated data provided by the monitoring programme, with the knowledge they would be reviewed and agreed upon in the WQRA collaborative workshop.

3.6.8 Combined with the standardised consequence ratings, the likelihood ratings populated each WQRA spreadsheet with overall risk scores for each parameter at every stage.

Data flows

3.6.9 Having populated the risk assessment with risk scores, gaps in data for certain stages or variations in scores between adjacent stages were evident. Therefore, to ensure a sensible flow of risk scores from catchment through to the reservoir, where no data was available for a particular stage of the WQRA, the risk rating was carried forward from an upstream stage where this data was available (e.g., the raw water conveyance stage). Furthermore, for parameters where risk ratings increased from an upstream to a downstream stage, the transition was retained and discussed in the workshop.

Limiting hazards

3.6.10 An initial review of the Gate 1 and Gate 2 SESRO WQRAs indicated that the hazardous parameters that should be considered for analysis at gate three included algae, pathogens, cryptosporidium, turbidity, pesticides and metals as these parameters are key to developing the design of a water treatment works further downstream of SESRO.

3.6.11 Following this, the ACWG Water Quality Risk Framework Report recommends including analysis of limiting hazards from groups relevant to the type of SRO being studied, as seen in Figure 3.4.

Figure 3.4 WQ risk framework: limiting hazrd categories

Type of SRO -> Likely limiting hazards	Reservoir source	Ground water source	Influence of sewage	Raw water transfer	Treated water transfer
Pathogens – e.g. Cryptosporidium, viruses	✓	✓	✓	✓	✓
Emerging hazards – e.g. nitrosamines, 1,4-dioxane, PFAS	✓	✓	✓		
Acceptability due to change in chemistry – e.g. alkalinity	✓	✓	✓	✓	✓
Acceptability - taste and odour	✓	✓	✓	✓	✓
Pesticides – e.g. metaldehyde	✓		✓	✓	
Nitrate/Nitrite		✓	✓	✓	
Corrosion potential					✓
Change in metal types and form	✓	✓		✓	
Disinfection byproduct formation potential	✓		✓	✓	✓

Source: ACWG Strategic Framework Report

3.6.12 As SESRO contains a raw water transfer and a reservoir source, all but one of the limiting hazard categories were analysed. Taking at least one limiting hazard from each of these categories, an initial list of limiting hazards was developed in conjunction with the available data, as shown in Table 3.4

Table 3.4 Common water quality limiting hazards

Limiting Hazard	Category	Justification
E.Coli	Pathogen	E. Coli to be standard limiting hazard covering pathogens and requiring disinfection. E. Coli is likely to drive the development of the water supply scheme due to being an indicator of health risks. Escherichia coli (or, alternatively, thermotolerant coliforms) is the first organism of choice in monitoring programmes for verification, including surveillance of drinking-water quality. It is considered the most suitable indicator of faecal contamination (WHO GDWQ).
Cryptosporidium	Pathogen	Limiting hazard because the parameter is a microbiological contaminant uniquely treated. Cryptosporidium is likely to drive the development of the water supply scheme due to associated high health risks. Traditional methods of pathogen treatment are not effective against cryptosporidium.
Chromium	Change in metal types and form	Limiting hazard, derived from geology and industrial pollution. Legislation regarding levels of chromium in drinking water likely to change in near future and therefore has been identified as a potential risk.
Iron	Change in metal types and form	Naturally occurring limiting hazard requiring removal. Iron is likely to drive the development of the water supply scheme due to natural abundance in the catchment.
Manganese	Change in metal types and form	Naturally occurring limiting hazard requiring removal. Manganese is likely to drive the development of the water supply scheme due to natural abundance.
Bromate	Chemicals in drinking water	Derived from geology and industry and generated from bromide in water treatment. Although no historic pollution from industry identified in the catchment, there are concerns around bromate formation at subsequent treatment processes downstream.

Nitrate	Nitrate/Nitrite	Limiting hazard requiring removal as nitrate is likely to drive the development/viability of the water supply scheme due to associated health risks and formation potential of nitrite.
Nitrite	Nitrate/Nitrite	Limiting hazard requiring removal as nitrite is likely to drive the development/viability of the water supply scheme due to associated health risks.
Pesticide: total	Pesticides	Limiting agricultural chemical hazard requiring removal. Pesticides are likely to drive the development/viability of the water supply scheme due to associated high health risks.
Dirty discoloured water	Acceptability	Limiting hazard because parameter is likely to drive acceptability of water supply scheme by consumers and therefore requires adequate treatment and mains conditioning flows.
Odour	Acceptability	Limiting hazard because parameter is likely to drive acceptability of water supply scheme by consumers and therefore requiring treatment. Derived from biological activity in the catchment, River Thames and the reservoir.
Taste	Acceptability	Limiting hazard because parameter is likely to drive acceptability of water supply scheme by consumers and therefore requiring treatment. Derived from biological activity in the catchment, River Thames and the reservoir.
Change in source type	Acceptability	Limiting hazard because although for transfer option 1, where flows in the River Thames are augmented by SESRO which do not impact downstream abstractions, direct transfer to T2ST in option 2 means some customers could potentially receive water from a different source as part of the T2ST SRO.
Pathogens	Pathogens	This parameter is to be a standard limiting hazard covering viruses and therefore requiring disinfection. Viruses are likely to drive viability of water supply scheme due to associated health risks.

INNS	Parameters used in design	Identified as a limiting hazard, although no new sources of water are associated with SESRO, recreational activities in the reservoir could cause a transfer of INNS.
PFAS- PFOS and PFOA	Emerging Hazard	Identified as a parameter belonging to the perfluoroalkyl substances (PFAS) emerging hazard of concern group. The DWI Tier 3 Regulation 4 (2) (wholesomeness) guidance value for PFOS and PFOA of 0.1µg/l has been used to assess the risk where data is available.
Turbidity	Pathogens and acceptability	Turbidity is likely to drive the development of the water supply scheme, specifically plant design and operability. The turbidity of the water needs to be below 1.0 NTU when it enters the disinfection process to comply with DWI Regulation 26. It is also likely to drive the acceptability of the water supply scheme by consumers and therefore requires removal.
Algae	Acceptability	Limiting hazard because parameter can impede the effectiveness of the clarification and filtration processes and can have an impact on customer acceptability.
Metaldehyde	Pesticides	Metaldehyde is selected as a limiting hazard because it is recognised as being particularly challenging to remove from water. Therefore, it could drive the treatment process selection.

Source: Mott MacDonald

3.6.13 Any further option-specific water quality hazards deemed likely to drive the development and/or acceptability and/or viability of the SRO or water supply scheme were then assessed. These limiting hazards were determined using water quality monitoring data sets and water quality expert knowledge during the workshops. By choosing parameters that were either high risk in the water quality monitoring suite, above Water Supply (Water Quality) Regulations 2018 limits or could not be mitigated or covered by another limiting hazard, a list of the key parameters for SESRO was produced. These additional limiting hazards are shown in Table 3.5. The key parameters were reviewed and confirmed during the first collaborative WQRA workshop and were deemed appropriate for all transfer options, utilising the expert knowledge of representatives from Thames Water, Affinity Water, Southern Water, Atkins Realis and Mott MacDonald.

During the workshop two further limiting hazards were identified, as shown in Table 3.5.

Table 3.5 Additional limiting hazards for SESRO

Limiting hazard	Justification
Chlorate	Disinfection byproduct - only relevant in treatment and distribution networks. Included as a limiting hazard to align with downstream SRO options.
Aluminium	Naturally occurring limiting hazard requiring removal. Likely to drive acceptability of water supply scheme by consumers further down the source to consumer tap pathway.

Source: Mott MacDonald

3.7 Strategic WQRA workshop

3.7.1 For option 1 and option 2 described in section **2.5.** the following WQRA workshop process was followed:

1) Introduction to WQRAs and a summary of the transfer option to be studied.
2) Identification of relevant limiting hazards.
3) Review of the draft pre-mitigated risk scores (both likelihood and consequence).
4) Identification of appropriate mitigation measures.
5) Review of the draft post-mitigated risk scores (both likelihood and consequence).
6) Detailing of any residual risk considerations.

3.7.2 The ACWG guidance states a collaborative workshop between all SRO stakeholders must be completed to fulfil the recommendations outlined in section 7 (RAPID) of the DWI Guidance Note on Resilience of Water Supplies in Water

Resources Planning.

3.7.3 The workshop began with an introduction to water quality risk assessments and a summary of the relevant transfer option. The WQRA draft methodology was discussed and the drafted WQRA was reviewed using the spreadsheet tool. Before investigating each limiting hazard relevant to the transfer option, the data sets used were reviewed to confirm whether they appropriately represented the hazards identified.

3.7.4 Next, the spreadsheets were filtered to show limiting hazards chosen during drafting. The lists of limiting hazards were discussed and agreed to be representative of the water quality risks faced by the scheme. At the beginning of the workshop any missing limiting hazards which were previously not considered were agreed to be included as they were deemed by those present to likely drive the development and acceptability of the scheme.

3.7.5 Having identified the relevant limiting hazards, the draft likelihood scores of all parameters were then reviewed across all relevant stages. Where necessary, scores were updated based on attendees' expert opinions. During this likelihood review, appropriate control measures were discussed for each limiting hazard and updated accordingly. Where applicable, residual risk considerations were noted, and actions listed. These actions detailed the treatment technologies to be included in the option design and where further information was required for WQRA analysis in gate three.

3.8 Check outputs

3.8.1 By reviewing and agreeing on data sources in the strategic WQRA workshop, it is assumed that all the appropriate and available water quality risk information has been identified. Where data is yet to be drawn into the assessment, this has been noted with the aim of filling the identified data gaps for Gate 4. Outputs from the assessments were shared and checked within the workshop with members from the connecting T2ST teams to accurately reflect these risks.

4 Water Quality Results

4.1 Atkins Realis targeted monitoring programme

4.1.1 Throughout gate two and gate three, a targeted water quality monitoring programme was implemented to provide up-to-date quantitative information on the water quality of the catchment source at the proposed abstraction location for SESRO. This data provides an insight into the raw water quality and background contamination levels of the catchment. Data was available between December 2020 and May 2023 and therefore no data beyond May 2023 was included in the results.

4.1.2 Table 4.1 provides a summary of the water quality data results for the limiting hazards identified at gate three, as well as some emerging hazards.

Table 4.1 Water Quality summary at Culham Intake from the targeted monitoring programme

Parameter	Minimum	Mean	Maximum	95%ile	90%ile	10%ile	PCV	Units	Count
E.coli	78	1306	2420	2420	2420	460	0	MPN/100ml	32
Cryptosporidium	0	0.219	5	1	0	0	0	no/litre	32
Iron (total)	31	176	590	364	302	76	200	ug/l	33
Manganese (total)	5.7	12	28	17.8	15.8	8	50	ug/l	33
Bromate	0.4	0.85	1	1	1	0.400	10	ug/l	32
Bromide	0.5	0.5	0.5	0.5	0.5	0.5	-	mg/l	31
Nitrite	0	0.219	1.1	0.88	0.56	0.02	0.1	mg/l NO2	65
Nitrate	5.42	20	60	41	36	6	50	mg/l NO3	65
Pesticides: Total	0.006	0.098	0.131	0.131	0.131	0.063	0.5	ug/l	33
Metaldehyde	<0.02	0.012	0.07	<0.02	<0.02	<0.02	0.1	ug/l	32
Total Organic Carbon (TOC)	2	4	10	6	6	3	-	mg/l	33
Chromium (III) dissolved	0.500	1	12	3	2	0.5	-	ug/l	33

Chromium (VI)	0.025	2	<7	<7	<7	0.025	3	ug/l	34
Chromium total	0.125	0.890	4	3	2	0.125	50	ug/l	33
Nonylphenol (Endocrine disrupting compounds)	0.02	0.024	0.08	0.05	<0.04	<0.04	-	ug/l	33
PFOS and its derivatives	0.0036	0.006	0.011	0.009	0.009	0.0045	≥0.1	ug/l	22
Tritium	<10	<10	<10	<10	<10	<10	100	Bq/l	32
Lead	0.045	0.526	3	1	0.898	0.188	10	ug/l	33
Turbidity	0.5	13	190	17	16	2	1	NTU	32
Algae (as Chlorophyll)	<20	<20	<20	<20	<20	<20	-	ug/l	32
Pathogens (somatic coliphages)	0.5	0.75	2	2	1	0.5	0.5	pfu/ml	8
Chlorate	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	0.25[14]	mg/l	8
Aluminium	17	121	490	313	259	42	200	ug/l	32
NDMA	0.0005	0.0007	0.002	0.001	0.001	0.0005	-	ug/l	8

4.2 CEH PROTECH modelling

4.2.1 During gate three, PROTECH Modelling by CEH was completed to support the design development of SESRO. This included modelling algal biomass changes in the proposed reservoir. Results indicated there would initially be a low biomass of algae in the SESRO reservoir.

4.2.2 Peaks of algal biomass may be expected in late spring/first half of summer. Subsequently, algal biomass is shown to decrease due to the consumption of nutrients initially input into the reservoir during the filling period in autumn/winter.

4.2.3 The output of the two simulation periods, a four year drought period and a two year drought period, are shown in Figure 4.1 and Figure 4.2 below.

[14] DWD proposed guidance on chlorate levels in drinking water

Figure 4.1 Changes in algal concentration in SESRO during a four year drought period scenario

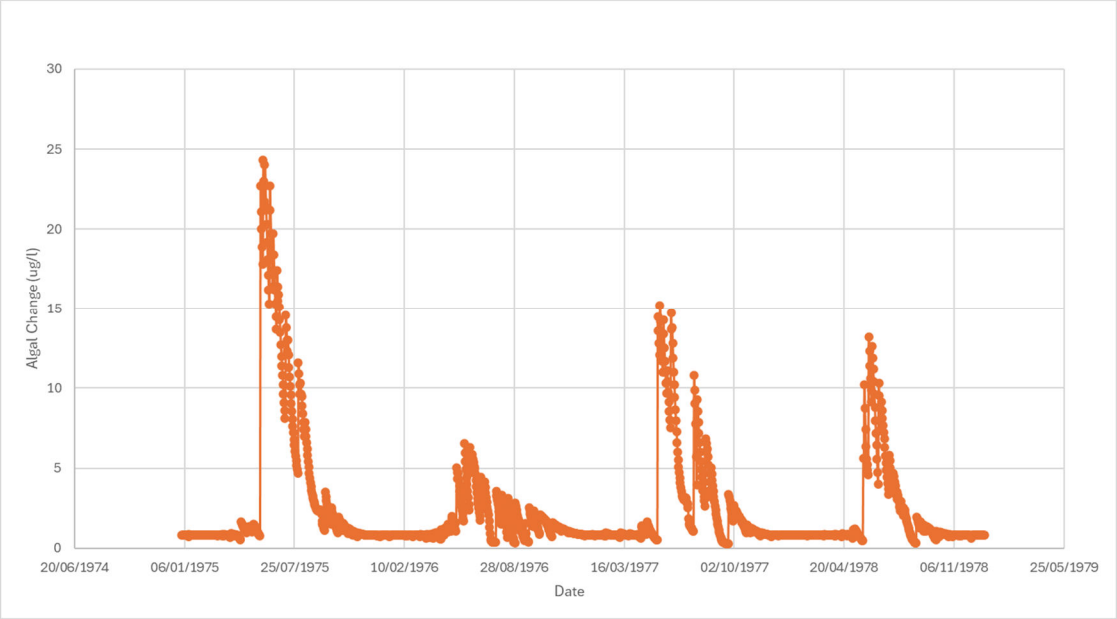
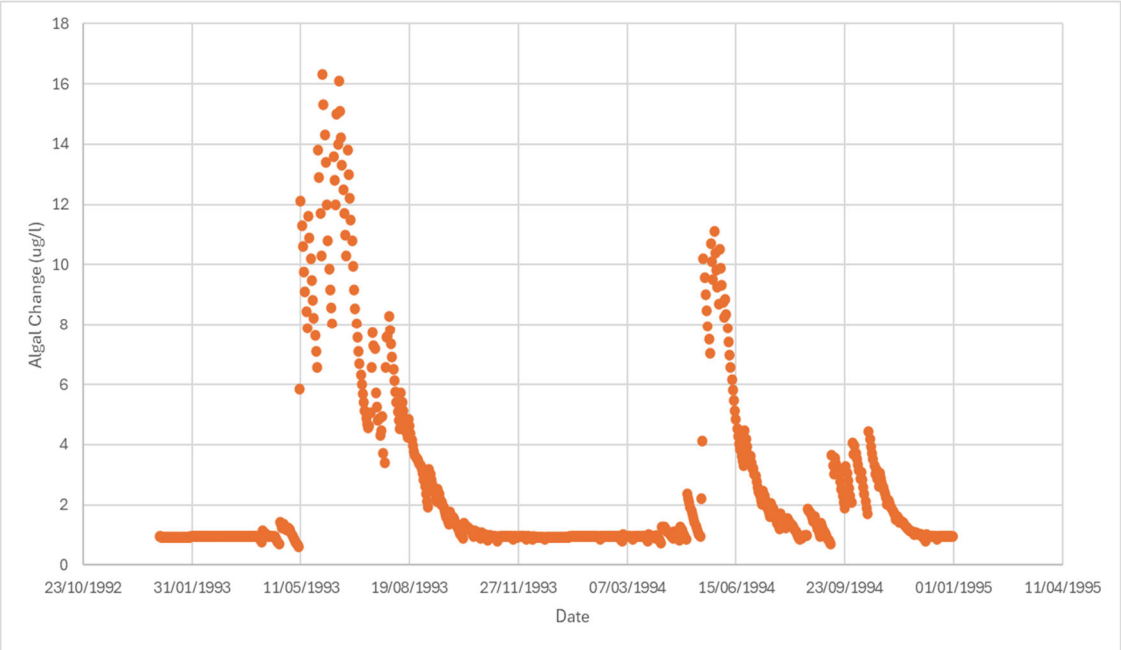


Figure 4.2 Algal changes in SESRO during a two year drought period scenario



4.3 Infoworks modelling - water quality modelling of the River Thames and SESRO reservoir

4.3.1 Additional modelling work has been carried out by to simulate any changes in

water quality in the River Thames and the SESRO reservoir as a result of operation of the reservoir. Results from this modelling have been used to select the limiting hazards studied in the respective WQRA stages and are detailed in Appendix 1 and 2. The modelling shows that SESRO is not likely to increase concentrations of chemicals downstream of the discharge location but will likely reduce concentrations of certain parameters. This means downstream companies are unlikely to be severely impacted by the operation of this scheme during periods of drought. Individual parameter graphs can be seen in Appendix 3.

5 Discussion of Drinking Water Quality Risk Assessment results

5.1 Gate three results

Limiting hazards with high risk scores

5.1.1 The following limiting hazards were assigned high risk scores at gate three

- Pathogens (faecal bacteria/virus): Enterococci, *E.coli*, Clostridium perfringens, coliform bacteria.
    - Additionally, as in Gate 2, somatic coliphages were identified as a high risk.
- Cryptosporidium
- Pesticides, total pesticides, individual pesticides
    - Metaldehyde scored as a medium risk
- Taste/odour
- Mycrocystin/algal toxins
- Algae
- Geosmin/MIB

Pathogens including cryptosporidium

5.1.2 The water quality monitoring programme indicated multiple pathogens, indicative of faecal bacteria, are present in the River Thames, including Enterococci, *E.coli*, Clostridium perfringens and coliform bacteria. Somatic coliphages, which are viruses derived from faecal contamination and sewage, were also present above the WSR2018 prescribed concentration or value (PCV) limits at consumers' taps. As such, the risk these parameters posed remained high in the WQRAs.

5.1.3 Cryptosporidium was also agreed to present a high risk to drinking water quality due to measured breaches in the PCV limits. The level of attenuation of cryptosporidium in the reservoir due to sedimentation is not yet confirmed. To reflect this level of certainty, it was agreed in the workshop to keep the risk to water quality from cryptosporidium as high. To reduce the risk of health impacts on consumers, it is assumed the majority of removal or inactivation of cryptosporidium would happen further downstream in a connected water treatment works and therefore it is important that any connecting SROs are able to deal with cryptosporidium loads. Mitigation technologies which may be considered for protection from cryptosporidium include ozonation and UV disinfection.

Algae

5.1.4 The River Thames supports large populations of algae, particularly in the spring. The reservoir is also likely to generate or increase large algal populations. Modelling of the reservoir indicates a decrease in algal populations after river abstraction ceases, as nutrient concentrations decrease due to biological activity. This can be seen in Figure 4.1and Figure 4.2. Algal presence subsequently increases when the reservoir is filled.

5.1.5 Algal blooms in the reservoir also can cause taste and odour issues as well as presenting algal toxin risks from cyanobacteria. Therefore, it was decided in the workshop that the algae risk score should remain high.

5.1.6 Mixing within the reservoir was identified as a method of mitigating the impacts of algal growth. During the workshop, in agreement with the water quality experts present, the choice of process steps at the downstream water treatment works (particularly for the T2ST transfer) was discussed to best cope with high algal loads.

Emerging hazards

5.1.7 Since Gate 2, the water quality monitoring programme has included monitoring for parameters considered emerging substances, as identified by the Environment Agency's Prioritisation and Early Warning System (PEWS), such as bisphenol, Fipronil, Metconazole, Propiconazole, Pyrene, Tri-(2-chloroethyl) phosphate, and Triclocarban, along with parameters from the Drinking Water Directive (DWD)[15].

5.1.8 Data was available for nonylphenol and 17-beta estradiol, which are both considered endocrine disrupting compounds. Results indicated the maximum concentrations of these in the raw water were 0.08µg/l and <0.0003 µg/l respectively. Both compounds are on the Drinking Water Directive (DWD) watch list with proposed limits of 0.3µg/l limit for nonylphenol, and 0.001µg/l for 17-beta estradiol. As the maximum measured concentrations were below the proposed limits, they were not considered necessary to include as limiting hazards and did not indicate a high risk to drinking water quality.

Chromium

5.1.9 Current chromium levels in the River Thames all indicate levels below the DWD prescribed concentration value of 50 µg/l. However, this value is currently being

[15] Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption. Official Journal of the European Union, L 435, pp. 1-62. | 04/11/2024 | European Union. (2020).

revised in the DWD to a value of 25 µg/l. Despite the revision, the maximum measured concentration of 4µg/l in the River Thames still falls below this.

5.1.10 The DWI guidance[16] on chromium and chromium VI indicates that for sites with concentrations between 3µg/l and 10 µg/l, it is recommended to monitor possible chromium sources and liaise with the Environment Agency to identify sources and determine catchment solutions. The monitoring programme limit of detection (LOD) for chromium VI (<7µg/l). This resulted in difficulties assessing the chromium concentrations in the river. The LOD for total chromium was therefore further reduced to <0.05µg/l from <7µg/l. Current total chromium levels do not indicate a risk to drinking water quality with an average of 1.88 µg/l since June 2022.

Per and polyfluoroalkyl substances

5.1.11 Per and polyfluoroalkyl substances (PFAS) are a group of manufactured organofluorine chemicals with a wide range of implications on water quality. Two types of PFAS, PFOS (perfluorooctane sulphonate) and PFOA (perfluorooctanoic acid) are of particular concern as they are widely used and were therefore identified as limiting hazards. These substances bioaccumulate, are not readily biodegradable and are considered to present a high risk to drinking water quality due to their impact on human health.

5.1.12 During Gate 2, an update to the monitoring programme was made to incorporate monitoring of an additional 4 PFAS, to a total of 51 PFAS as recommended by the Drinking Water Inspectorate (DWI), which identify PFAS as a significant emerging hazard. These were added in June 2022 but not evaluated at Gate 2 as the data set was not yet comprehensive enough.

5.1.13 Updates to the DWI Guidance on Water Supply (Water Quality) Regulations 2016 specific to PFAS[17] classify PFAS (including PFOS and PFOA) levels into three tiers. Tier 1 is for PFAS at a concentration of <0.01 µg/l, Tier 2 is <0.1 µg/l and Tier 3 is > or equal to 0.1 µg/l. PFAS levels between 0.01 µg/l and 0.1µg/l are to be highlighted as drinking water quality risks to the potential impact on wholesomeness of consumers' supply.

5.1.14 The WQRAs indicate residual risks for PFAS remain high for both options. Although the data collected does not show levels of PFAS regularly exceeding the DWI tier limits in the catchment, there were a few sample instances of PFOS concentrations breaching into Tier 2 in 2022. The catchment is therefore classified as Tier 2 and additional mitigation measures need to be adopted. As

[17] Guidance on the Water Supply (Water Quality) Regulations 2016 (as amended) for England and Water Supply (Water Quality) Regulations 2018 for Wales specific to PFAS (per- and polyfluoroalkyl substances) in drinking water | August 2024 | Drinking Water Inspectorate

such, it was decided in the workshop that the risk score for PFAS is to remain high to ensure continued monitoring, to account for possible future legislation changes, and to and to ensure the risk PFAS presents is considered in downstream SRO water quality assessments.

5.1.15 A Tier 2 PFAS classification risk requires a review of scheme control measures; communication with the Liaison Inspector if final water results exceed company's internal limits; preparation of mitigations to prevent the supply of water to consumers with >0.1µg/l PFAS and liaison with UKHSA and health authorities as per DWI guidance. In response to this, the additional mitigation measures discussed in the workshop included Granular Activated Carbon (GAC) filtration in the concept design for the option 2 T2ST transfer and possible blending with other non-tier 2 sources of water to decrease PFAS concentrations.

Customer acceptability

5.1.16 The RAPID strategic regional water resource solutions guidance for gate three document[18] specifies evidence should be provided in the gate three submission of stakeholder and consumer engagement, paying particular attention to consumers and stakeholders who will receive water from a different or blended source. Under the Water Supply (Water Quality) Regulations 2018, the taste and odour of the water must be acceptable to consumers.

5.1.17 Gate 2 customer engagement indicated that reservoirs were generally viewed positively as a water source, being described as more 'natural' and assumed to likely be of higher quality. The issue of water quality was not the main concern, with the majority of concerns raised regarding the constructability, operation and resilience of reservoirs themselves.[19]

5.1.18 The gate three design underwent public consultation in June 2024. Although the consultation did not focus on drinking water quality, any feedback gathered that may impact the scheme design will need to be reviewed before the next stage of DWQRA. If any relevant changes are made, their impact on drinking water quality will need to be assessed.

5.1.19 Detailed community engagement and formal consultation will be completed for SESRO. This should be done in conjunction with other SRO schemes closer to the point of development of the SESRO reservoir and will consider the effects of construction and operation of the SRO. The engagement will also consider how the scheme will impact consumers who will receive water from SESRO. Thames Water, Southern Water and Affinity Water will be required to show evidence of

18 Strategic regional water resource solutions guidance for gate two | Regulators' Alliance for Progressing Infrastructure Development | April 2022 | Ofwat
19 RAPID Gate 2 Submission Supporting Technical Document D: Stakeholder and Customer Engagement, November 2022

communication of the SRO design to consumers as well as producing evidence of addressing and including any concerns raised in the design.

5.1.20 Implementation of the SESRO is not expected to cause a categorical change in water quality for most recipients currently receiving water sourced from the River Thames. As such, the risk to customer acceptability at the initial stages is low. However, this risk may be greatly increased for downstream SRO connections which may have consumers receiving water from a different or blended source. It was discussed in the workshop that these risks should be accurately captured in any downstream water quality risk assessments along the “source to tap” pathway.

Other physical limiting hazards and water quality events

5.1.21 In the workshop, the importance of including mixing in the reservoir was discussed, particularly due to the depth of the proposed storage volume. Poor mixing could cause sedimentation at the bottom of the reservoir and stratification of stored water, with potential for increased algal growth and high turbidity spikes. Fluctuating flow velocities into SESRO due to varied abstraction profiles from the River Thames could cause deposits sedimented at the bottom of the reservoir to become displaced.

5.1.22 If abstraction from SESRO were to occur during suspension of sediment in the water, this could cause severe operational and compliance issues in the treatment process. Poor mixing in the reservoir could also cause a lack of oxygenation and therefore increase the presence of hazardous parameters. Issues with mixing and aeration are to be mitigated by appropriate maintenance, and inspection strategies, of the reservoir assets to minimise the risk of equipment malfunction.

5.1.23 The scheme concept design currently allows for activities such as recreational sailing, canoeing etc on the reservoir. This means boats and water sport equipment could be brought to site, posing a risk of transferring INNS into the reservoir. The recreational strategy at gate three is still in the early stages of development. The development of clear guidelines on equipment condition and upkeep alongside customer engagement is recommended to mitigate INNS transfer risks.

5.1.24 Recreational activities in the reservoir also pose the risk of causing pollution events. Damage to recreational equipment and assets could lead to the ingress of contaminants into the reservoir water. Careful monitoring of the water quality and asset inspection programmes, alongside customer engagement regarding appropriate behaviour whilst engaging in recreational activities will help mitigate this risk.

5.1.25 Abstraction from the reservoir during periods of poor water quality could potentially cause issues with downstream water treatment plants. Storm events

may flush through contaminants such as dirty/discoloured water, pathogen break through and high pesticide concentrations. Water quality monitoring should be implemented at the reservoir and abstraction strategies put in place to reduce the risk of poor water quality impacting downstream processes.

5.1.26 Pollution events associated with industry operations upstream of the River Thames have also been identified as a potential hazardous event. Liaison with stakeholders upstream of SESRO abstraction and careful water quality monitoring of the River Thames help reduce the risk of abstraction in the case of a pollution event.

5.2 Control measures

5.2.1 Currently SESRO has the following control measures:

- Reservoir management controls:
  - Mixing and aeration.
  - Intakes at various depths.
  - Eutrophication management in the upstream catchment.
  - Pesticide usage management in the upstream catchment,
- Emerging hazards (including PFAS):
  - Continue catchment management according to Thames Water management plans, including liaising with potential sources of contamination (e.g. airport, airfields and airstrips, fire training centres/fire stations, wastewater discharges and trade effluents).
  - GAC to be considered as part of the treatment design for the Option 2 T2ST direct transfer, alongside a consideration for blending of water sources as a control measure.
- Pollution incident response measures.
- Water quality monitoring to guide abstraction from the River Thames and discharge from the reservoir to the River Thames.
- Water quality monitoring in the reservoir to guide abstraction to downstream water treatment works.
- Liaison with water companies to ensure water treatment works are capable of dealing with the algal loads expected in the reservoir and River Thames.
- INNS transfer controls at the raw water intakes and discharge locations. This includes screens at the inlet into the reservoir; increasing visitor awareness of transfer pathways and controls on recreational activities within the reservoir and surrounding area (if allowance for activities such as water sports continue to be incorporated in the design).

5.3 Key workshop conclusions

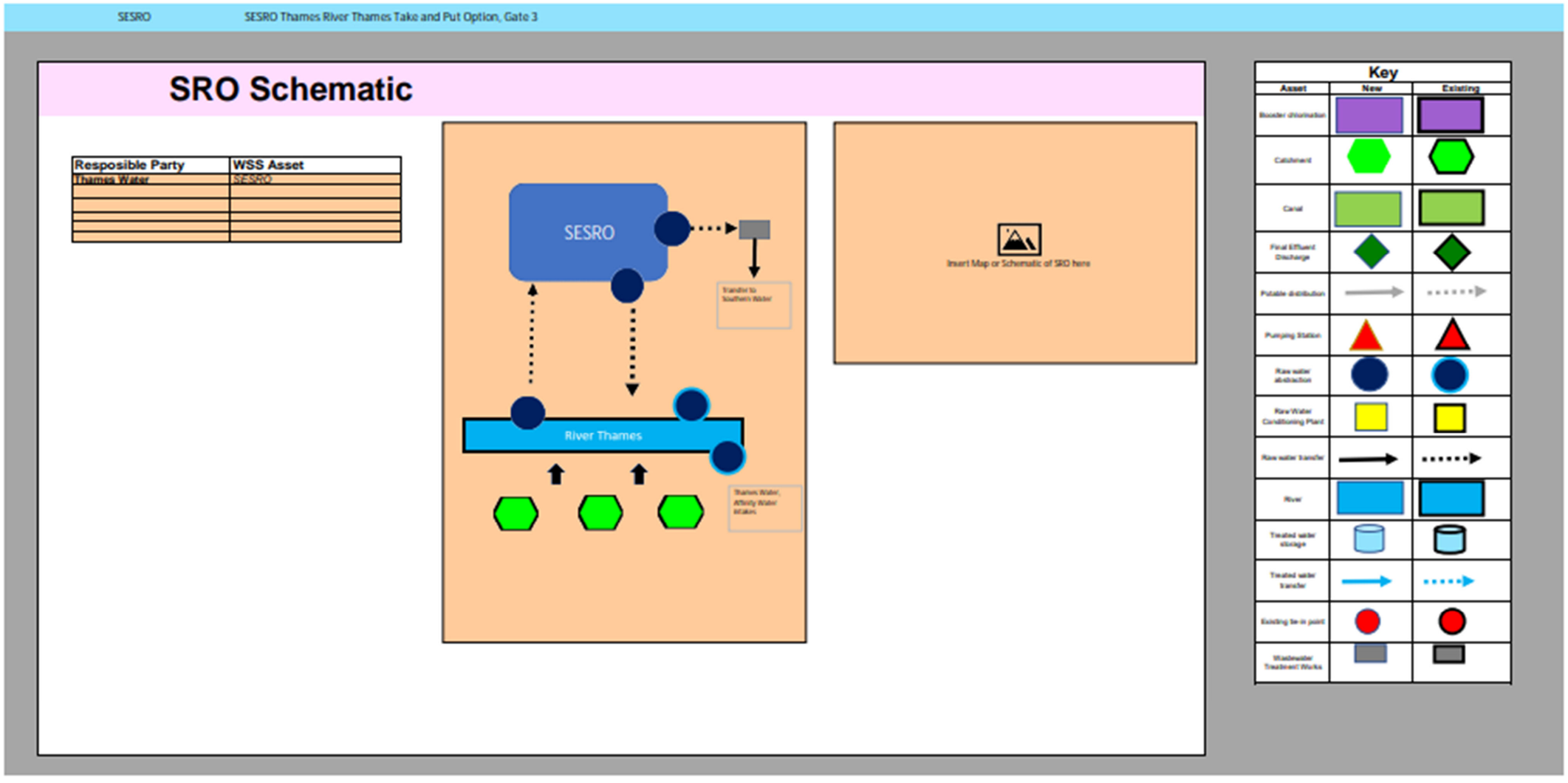
5.3.1 The key conclusions of the drinking water quality risk assessment workshops are as follows:

- At future gates, consider the discharge location of the Abingdon Sewage Treatment Works into the River Thames to ensure there is sufficient distance between the intake for SESRO and the sewage treatment works discharge.
- Continue monitoring for emerging hazards.
- Review the results of the river and reservoir modelling, including algal load modelling, and factor any outputs into the WQRA risk scoring. This has since been completed.
- Provide comments on sedimentation and mixing in the reservoir as mitigation measures against poor reservoir water quality.
- Follow up with the T2ST SRO water quality team to ensure the DWQRAs are aligned, as SESRO is ahead of T2ST in the RAPID gated process.

6 Recommendations for future work

6.1.1 The following recommendations have been identified to carry throughout gate three and through subsequent gates:

- Review plans to relocate the Abingdon Sewage Treatment Works outfall in relation to the SESRO raw water intake location on the River Thames to ensure enough distance between the two.
- After further updates to the recreational strategy for the SESRO reservoir, review the potential impact on reservoir water quality and ensure appropriate mitigation measures are put in place.
- Continue the water quality monitoring programme to provide a comprehensive quantitative data set for informing future risk likelihood scores and to establish any patterns in seasonality. Where possible, review and improve the scope of the monitoring programme to include monitoring for emerging contaminants.
- Continue to monitor parameters for which regulatory changes may come into effect e.g. PFAS, chromium, endocrine disrupting compounds and NDMA.
- Integrate the SESRO WQRA spreadsheet outputs into the relevant downstream stages of linked SROs in the 'catchment to tap' pathway and any possible future connections into SESRO.
- Continue to plan customer engagement regarding acceptability of the scheme. This is particularly important where changing water source may lead to customer acceptability risks regarding the aesthetic qualities of water (colour, taste and odour).
- Review the T2ST gate three DWQRA findings and incorporate any additional limiting hazards found, which are relevant to the SESRO scheme, in the next stage of DWQRA assessment.


SESRO
SESRO Thames River Thames Take and Put Option, Gate 3
SRO Schematic
Resposible Party
WSS Asset
Thames Water
SESRO
SESRO
River Thames
Transfer to Southern Water
Thames Water, Affinity Water intakes
Insert Map or Schematic of SRO here
Key
Asset
New
Existing
Booster chlorination
Catchment
Canal
Final Effluent Discharge
Potable distribution
Pumping Station
Raw water abstraction
Raw Water Conditioning Plant
Raw water transfer
River
Treated water storage
Treated water transfer
Existing tie-in point
Wastewater Treatment Works

SESRO **SESRO Thames River Thames Take and Put Option, Gate 3**

			Catchment										Abstraction (Reservoir)								
			Pre-mitigated					Post mitigated					Pre-mitigated					Post mitigated				
Data source and certainty input	Limiting Hazard	Parameter details and commentary	Likelihood	Consequences	Risk	Risk Commentary	Control	Likelihood	Consequences	Residual risk	Residual risk considerations	Actions	Likelihood	Consequences	Risk	Risk Commentary	Control	Likelihood	Consequences	Residual risk	Residual risk considerations	Actions
Escherida Coli	Y	Faecal pathogens derived from sewage, livestock, human activity and wildlife in the catchment.	5	5	25	Gate 3: Likelihood score increased as multiple PCV breaches in the last year in accordance to ACWG methodology.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	5	5	25	Cannot be sufficiently reduced within the catchment to modify downstream actions. Reservoir will reduce risk but only in abstracted water. Mitigation primarily in treatment.	Gate 3: Consider moving the abstraction point upstream of Abingdon sewage discharge locations as mitigation.	5	5	25	Likelihood risk carried over from Catchment stage	Little scope to control at the abstraction point as present at all times	5	5	25	None	None
Cryptosporidium	Y	Derived from livestock and sewage in the catchment. Spores can survive for a long time in the environment.	4	5	20	Gate 3: Inclusion as limiting hazard due to high residual risks and potential downstream treatment implications, as well as alignment with downstream SRO's. PCV breached within the last 2 years in November 2022. Gate 2: Because of the health risk a consequence score of 5 has been applied	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	4	5	20	Cannot be sufficiently reduced within the catchment to modify downstream actions. Reservoir will reduce risk but only in abstracted water. Mitigation primarily in treatment.	None	4	5	20	Likelihood risk carried over from Catchment stage	Gate 3: Possible sedimentation of cryptosporidium. Gate 2: Controls of abstraction would help during periods of high loads with river turbidity high.	4	5	20	Risk cannot be sufficiently reduced in the reservoir/abstraction to modify treatment requirements downstream	Review abstraction strategy in relation to Cryptosporidium risk at intakes
Chromium	Y	Derived from industry and geology.	2	5	10	Gate 3: No change in Gate 2 likelihood score of 2 as at Datchet intake average concentration= 0.65 ug/l, 95%ile concentration = 1.39 ug/l, Chromium VI - 1 instance of 27 ug/l in 2023. Gate 2: Observed data indicates low risk. Consequence aligned with DWI guidance following workshop.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, Customer Complaint Procedures, ERD for event actions & notification criteria; Operational standards & procedures with review process; controls on abstraction to SESRO in response to pollution incident	2	5	10	Medium Risk	None	2	5	10	Likelihood risk carried over from Catchment stage	Cease abstraction of concentrations in reservoir high	2	5	10	None	None
Iron	Y	Primarily derived from geology. Sewage works can be an issue where iron dosing. Can be generated from reservoir sediment under low DO conditions.	5	3	15	Gate 3: Likelihood score increased from Gate 2 to a score of 5 following the ACWG methodology, as the Culham intake average concentration =176.12 ug/l, 95%ile concentration = 364 ug/l, Datchet Intake average concentration= 141.71 ug/l, 95%ile concentration = 314 ug/l with multiple PCV exceedances in the last year. Sunnymeads intake average concentration= 143.14 ug/l, 95%ile concentration = 332 ug/l Gate 2: Added as limiting hazard after Gate 1 workshop. SRO monitoring shows concentrations above Drinking Water standard. Consequence aligned with DWI guidance following workshop.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; permitting at sewage works. Reservoir aeration will reduce release from sediments. Controls on abstraction to SESRO in response to pollution incident.	5	3	15	As largely natural origins difficult to mitigate against in catchment.	Review of sources of iron to assess whether any significant non geological sources.	5	3	15	Likelihood risk carried over from Catchment stage	Gate 3: Potential to reduce risk if cease abstraction from SESRO if reservoir concentrations high. Reservoir aeration will reduce release from sediments. Controls on abstraction to SESRO in response to pollution incident.	4	3	12	As largely natural origins difficult to mitigate against completely	Gate 3: Not being able to abstract from SESRO during periods of refilling the reservoir impacts the direct abstraction of T2ST. High iron concentrations can also impact treatment train. T2ST design team to consider designing the WTWs to cope with high iron concentrations. Gate 2: Include in monitoring at reservoir abstraction point.
Manganese	Y	Primarily derived from geology. Can be generated from reservoir sediment under low DO conditions.	3	3	9	Gate 3: No change in Gate 2 likelihood score of 3 as the Culham intake average concentration =12 ug/l, 95%ile concentration = 17.8 ug/l, Datchet Intake average concentration= 10.62 ug/l, 95%ile concentration = 16.1 ug/l, Sunnymeads Intake average concentration= 10.96 ug/l, 95%ile concentration = 18.2 ug/l Gate 2: SRO monitoring shows concentration in River Thames above Drinking Water standard. Consequence aligned with DWI guidance following workshop.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; reservoir aeration will reduce risk of release from sediment. Controls on abstraction to SESRO in response to pollution incident.	3	3	9	As largely natural origins difficult to mitigate against in catchment.	None	3	3	9	Likelihood risk carried over from Catchment stage	Gate 3: Potential to reduce risk if cease abstraction from SESRO if reservoir concentrations high	2	3	6	As largely natural origins difficult to mitigate against completely	Include in monitoring at reservoir abstraction point
Bromate	Y	Derived from geology and industry and generated from bromide in water treatment.	1	5	5	Gate 3: No change in Gate 2 likelihood score of 1 as the Culham intake average concentration =0.85ug/l, 95%ile concentration = 1 ug/l, Datchet Intake average concentration= 0.558 ug/l, 95%ile concentration =1 ug/l Gate 2: Observed data indicates low risk from catchment. Consequence aligned with DWI guidance following workshop. Confirmation with workshop attendees on severity of scoring.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans;	1	5	5	None	None	1	5	5	Likelihood risk carried over from Catchment stage	None required	1	5	5	Risk associated with oxidation of bromide during treatment	None
Nitrate	Y	Mainly derived from agriculture, atmospheric deposition and sewage.	2	5	10	Gate 3: No change in Gate 2 likelihood score of 2 as the Culham intake average concentration =20.32mg/l, 95%ile concentration = 41.2mg/l, Datchet Intake average concentration= 30.47 ug/l, 95%ile concentration = 36.2 ug/l, Sunnymeads Intake average concentration= 27.67g/l, 95%ile concentration = 36.4 ug/l Gate 2: Storage will tend to reduce risk because of denitrification. Consequence aligned with DWI guidance following workshop.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans; reservoir storage will reduce risk	2	5	10	Ongoing catchment measures and changes in agriculture may modify risks in the future.	None	2	5	10	Likelihood risk carried over from Catchment stage	Gate 3: Inlet jet system and bubble aerators, recirculation pumps	2	5	10	Impossible to eliminate risk as present at all times	None
Nitrite	Y	Derived from nitrogen sources in the catchment and sewage as well as low dissolved oxygen and reducing conditions. May also be produced in reservoir or distribution if low dissolved oxygen concentrations prevail.	5	2	10	Gate 3: Gate 2 likelihood score of 2 increased to 4 as the Culham intake average concentration =0.21mg/l, 95%ile concentration = 0.88mg/l, Datchet Intake average concentration= 0.185 mg/l, 95%ile concentration = 0.75mg/l, Sunnymeads Intake average concentration= 0.3 mg/l, 95%ile concentration = 0.92 mg/l. Likelihood score increased to a 5 in workshop. Gate 2: Observed data shows high concentrations in River Thames above PCV. Consequence aligned with DWI guidance following workshop.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; reservoir process will convert to nitrate at most times; aeration would reduce the risk of generation in the reservoir. Reduce abstraction if river concentrations high.	5	2	10	Source difficult to mitigate as environmentally dynamic.	Review sources and processes at next stage of the DWQRA.	5	2	10	Likelihood risk carried over from Catchment stage	Gate 3: Inlet jet system and bubble aerators, recirculation pumps	5	2	10	Impossible to eliminate risk as present at all times	Include in monitoring at abstraction point from reservoir Procedent in LTR on score reduction across reservoir. Water modelling access.
Pesticides: total	Y	Derived from agricultural and amenity applications of pesticides in the catchment. (Including propyzamide, mecoprop, MCPA, glyphosate, fluroxypyr, flufenacet, diclofol, clopyralid, carbetamide, bentazone, 2,4-dichlorophenoxyacetic acid (2,4-D))	5	4	20	Gate 3: PCV exceedances for multiple pesticides in the catchment throughout the last two years. No change in Gate 2 likelihood score of 5. Intake modelling does not consider Pesticides, however total phosphorous and orthophosphate is included in the modelling. Gate 2: Consequence aligned with DWI guidance following workshop. This downgrades risk category.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans; AMP funded solution; Controls on abstraction to SESRO in response to pollution incident.	5	4	20	Ongoing catchment measures and changes in agriculture and industry may modify risks in the future. Reservoir storage will reduce risk in comgponent abstracted to reservoir but may return loads to river in summer.	Review catchment measures and new pesticides when they become available or their usage changes. Include in water quality modelling work. Process to review emerging pesticides and change in usage	5	4	20	Likelihood risk carried over from Catchment stage	Catchment monitoring of pesticide use, dilution effect of the reservoir, potentially cease abstraction when concentrations high	5	4	20	Requires frequent monitoring and immediate response Gate 3: Treatment includes GAC to mitigate risk downstream	Include in monitoring at intake
Polycyclic aromatic hydrocarbon:	N*	Associated with hydrocarbon and fossil fuel usage. Observed data indicates high risk. Consequence aligned with DWI guidance following workshop.	3	4	12	Gate 3: No change in Gate 2 likelihood score of 3 as the Culham intake average benzo(b)fluoranthene concentration = 0.004ug/l, 95%ile concentration = 0.009ug/l, benzo(k)fluoranthene average concentration= 0.002ug/l, 95%ile concentration = 0.005ug/l, benzo(g)perylene average concentration= 0.004ug/l, 95%ile concentration = 0.01 ug/l, indeno(1,2,3-cd)pyrene average concentration = 0.004ug/l, 95%ile=0.01ug/l Gate 2: Observed data indicates high risk. Consequence aligned with DWI guidance following workshop.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans; Controls on abstraction to SESRO in response to pollution incident.;	3	4	12	Generally at low background level but can be increased by pollution events, Reservoir will even out peaks.	None	3	4	12	Likelihood risk carried over from Catchment stage	Controls on abstraction to SESRO in response to pollution incident.	2	4	8	Remaining risk low to moderate	None
Benzo(a)pyrene	N*	Associated with hydrocarbon and fossil fuel usage. Observed data indicates moderate to high risk.	3	4	12	Gate 3: No change in Gate 2 likelihood score of 3 as the Culham intake average concentration = 0.01ug/l, Datchet Intake average concentration= 0.005ug/l, 95%ile concentration = 0.015ug/l, Sunnymeads Intake average concentration= 0.007ug/l, 95%ile concentration = 0.018ug/l. Gate 2: Observed data indicates moderate to high risk.	WQ Response Proocedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans; Controls on abstraction to SESRO in response to pollution incident.	3	4	12	Controls on abstraction to SESRO in response to pollution incident. Reservoir will even out peaks.	Not highlighted as a limiting hazard for SESRO at this stage of the DWQRA. Review the need to include as limiting hazard at the next stage and align with other SRO considerations downstream.	3	4	12	Likelihood risk carried over from Catchment stage	Gate 3: No change since gate 2 Gate 2: Possible dilution effect	2	4	8	None	None

SESRO **SESRO Thames River Thames Take and Put Option, Gate 3**

			Catchment									Abstraction (Reservoir)								
			Pre-mitigated				Post mitigated					Pre-mitigated					Post mitigated			
Data source and certainty input	Limiting Hazard	Parameter details and commentary	Likelihood	Consequences	Risk	Risk Commentary	Control	Likelihood	Consequences	Residual risk	Residual risk considerations	Actions	Likelihood	Consequences	Risk	Risk Commentary	Control	Likelihood	Consequences	Residual risk	Residual risk considerations	Actions
Dirty/discoloured water	Y	Present in natural waters	4	2	8	Gate 3: No change in Gate 2 likelihood score of 4 as the Culham intake average concentration =11.1 Hazen, 95%ile concentration =21.95 Hazen. Gate 2: Not included in existing DWSP	Gate 3: No change to WQ response procedures. Gate 2WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SQZs in catchment with associated action plans;	4	2	8	Need to investigate specific causes if discoloration occurs	None	4	2	8	Likelihood risk carried over from Catchment stage	Cease abstraction when water highly discoloured	3	2	6	Can lower risk but not eliminate	Include in monitoring at intake
Odour	Y	Mainly derived from biological activity in the catchment, River Thames and reservoir.	4	4	16	Gate 3: No change in Gate 2 risk likelihood of 4. Gate 2: No consequence score available in DWI guidance.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; eutrophication management will reduce risk of odour generation in the reservoir	4	4	16	As largely of natural origin and derived from many sources, it is difficult to mitigate against. Scores based on judgement as not included in existing DWSP.	Additional monitoring to determine if odour is an issue	4	4	16	Likelihood risk carried over from Catchment stage	Cease abstraction when high odour	3	4	12	Can lower risk but not eliminate	Include in monitoring at intake
Taste	Y	Mainly derived from biological activity in the catchment, River Thames and reservoir.	4	4	16	Gate 3: No change in Gate 2 risk likelihood of 4. No new updated data from Gate 2. Gate 2: No consequence score available in DWI guidance.	Gate 3: No change to WQ response procedures. Gate2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; eutrophication management should reduce risk of generation in the reservoir	4	4	16	As largely of natural origin and derived from many sources, it is difficult to mitigate against. Scores based on judgement as not included in existing DWSP.	Additional monitoring to determine of odour is an issue	4	4	16	Likelihood risk carried over from Catchment stage	Difficult to control as present in water source, potentially cease abstraction should parameters affecting taste e.g. high iron concentrations, geosmin etc. persist.	3	4	12	Can lower risk but not eliminate	Include in monitoring at intake
Change in source type (e.g. surface - groundwater)	Y	Surface water remains the only source.	2	1	2	Gate 3: As Gate 2 low risk for SESRO SRO as the source remains the same, however, downstream SROs will need to include treatment and Stakeholder engagement as control measures to reduce risk to consumers. Gate 2: Not included in existing DWSP. However, for downstream SRO's that do not currently have the River Thames as a water source or utilise groundwater sources, this will cause a change in source.	None	2	1	2	Not included in existing DWSP so risk scores based on judgement.	Further downstream SROs to include risk of changing water source in DWSPs. Include in future monitoring and review.	2	1	2	Likelihood risk carried over from Catchment stage	None required	2	1	2	Not included in existing DWSP so risk scores based on judgement.	Pass information on to T2ST on risk of changing sources.
Pathogens - *Bacteria, Viruses, Protozoa*	Y	Derived from sewage, livestock, human activity and wildlife.	5	5	25	Gate 3: Limiting hazard for viruses. Not included at Gate 2 but have been included both in STT and T2ST as an indicator of human and sewage activity due to population located around the river. Not expected to be requiring or needing additional control measures – potentially cause treatment problems if treatment isn't extensive enough leading to impacts on human health.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SQZs in catchment with associated action plans; storage will tend to reduce risk in water pumped to reservoir	5	5	25	Derived from numerous largely uncontrollable sources in the catchment. Reservoir will reduce risk because of natural losses of pathogens in storage. However due to the high degree of uncertainty the likelihood score has not been changed to reflect a high risk and to address concerns at downstream water treatment works.	None	5	5	25	Likelihood risk carried over from Catchment stage	Little option to control at the abstraction point as present at all times	5	5	25	Difficult to control at intake as level unpredictable and fast response impractical	None
Invasive non native species (INNS)	Y	No new sources of water associated with SESRO so no particular risk from invasive species.	4	4	16	Gate 3: Potential sources of INNS through recreation activities around the reservoir. Gate 2: Relevant to transfer of water downstream. Not included in existing DWSP	Gate 3: Screens at inlet into the reservoir, visitor awareness and controls on water sports within the reservoir and surrounding area. Gate 2: Specific controls need to be developed for INNS	3	4	12	Covered by INNS analysis in SESRO EAR	NA	3	4	12	Likelihood risk carried over from Catchment stage	Gate 3: Covered by INNS analysis in SESRO, WTW's within SESRO boundary to reduce the risk of INNS between different catchments.	3	4	12	None	Understand activities surrounding the reservoir to quantify risk.
Ammonium	N*	Derived from sewage, livestock and general biological activity in catchments, No Drinking Water Standard. Consequence scores aligned with DWI guidance.	4	1	4	Gate 3: No change in Gate 2 likelihood score of 4 as the Culham intake average concentration for ammoniacal N = 0.155mg/l, 95%ile concentration = 0.71mg/l, Datchet intake average concentration= 0.084mg/l, 95%ile concentration = 0.327mg/l, Sunnymeads intake average concentration= 0.085mg/l, 95%ile concentration = 0.268mg/l. Gate 2: No Drinking Water Standard. Consequence scores aligned with DWI guidance.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication ; Designated SQZs in catchment with associated action plans.	4	1	4	Ammonia concentrations in the River Thames are addressed by asset management to address environmental regulations including WFD. Can be generated through reservoir processes.	None	4	1	4	Likelihood risk carried over from Catchment stage	Gate 3: Dilution in the reservoir might attenuate impact on downstream treatment. Difficult to control as present at all times.	4	1	4	None	Challenging for potential downstream treatment.
Radioactivity(Alpha, Beta, Tritium)	N*	Determined by natural geological radioactivity. Observed data shows significant risk. Consequence score aligned with DWI guidance after workshop. Described as a screening value rather than an issue per se.	4	4	16	Gate 3: Observed data shows presence. Flagged as for alpha activity at Datchet the 1oD is above the WSR2016 PCV of 0.1 Bq/l. Not highlighted as a limiting hazard for GSWD during the workshop. Review the need to include as limiting hazard at the next stage and align with other SRO considerations downstream. Gate 2: Observed data shows significant risk. Consequence score aligned with DWI guidance after workshop. Described as a screening value rather than an issue per se.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Controls on abstraction to SESRO in response to pollution incident.;	4	4	16	Difficult to modify risk because determined by natural geological sources.	Not highlighted as a limiting hazard for SESRO at this stage of the DWQRA. Review the need to include as limiting hazard at the next stage and align with other SRO considerations downstream.	4	4	16	Likelihood risk carried over from Catchment stage	None required	4	4	16	None	None
Chlorate	Y	Disinfection by-product - only relevant in treatment and distribution. No consequence score available in DWI guidance.	1	3	3	Gate 3: No change in Gate 2 likelihood score of 2 as observed data indicates low risk (is at limit of detection) for Culham, Datchet Intake. No new data for Sunnymeads. Gate 2: No consequence score available in DWI guidance.	Not applicable at catchment stage.	1	3	3	NA	None	1	3	3	Likelihood risk carried over from Catchment stage	None required	1	3	3	None	None
beta - estradiol	N*	Derived from industrial and domestic chemical usage. Environmental levels tend to be high.	3	4	12	Gate 3: No change in Gate 2 likelihood score of 3 as there is no new observed data for Culham, Datchet, Sunnymeads intakes. Gate 2: Not included in pre-existing Thames DWSP. No Drinking Water Standard. No consequence score available in DWI guidance. Proposed watchlist standard in revision of Drinking Water standards = 0.001 ug/l.	Gate 3: No change in WQ response procedures. Gate 2:WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	3	4	12	Difficult to control as related to many individual usages of chemicals. Not in existing DWSP scores based on judgement	Include in future monitoring and review	3	4	12	Likelihood risk carried over from Catchment stage	Cease abstraction if concentrations high	3	4	12	None	Include in monitoring at intake
Perfluoro octane sulfonate (PFOS)	Y	Flame retardant - ubiquitous in surface waters.	5	3	15	Gate 3: Although no PCV exceedances of DWI Tier 3 guidance in Atkins monitoring suite, risk likelihood to remain high to account for possible future legislation changes and to align with downstream SROs. TW Datchet intake DWSP (Total PFOS =0.01ug/l on 2 occasions. 0.0161ug/l, 01/04/2022 and 0.0143ug/l, 01/07/2022.) Gate 2: Not included in existing DWSP. No consequence score available in DWI guidance. Proposed standard in revision to Drinking Water standards = 0.1ug/l.	Gate 3: As per Gate 2 WQ response procedures. Thames Water Datchet intake (2022) includes a watching brief is to be maintained as water quality sampling indicates potential raw water contamination from this source. Stakeholder engagement with fire brigades on current and future use. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	5	3	15	Gate 3: Difficult to control as widely present in environment without substance control use. Included in updated DWSPs. Gate 2: Difficult to control as widely present in environment. Not in existing DWSP - scores based on judgement - known high environmental levels	Continue to include in future monitoring and review	5	3	15	Likelihood risk carried over from Catchment stage	Difficult to control as present at all times Gate 3: Possible dilution effect of reservoir discharge during low periods of flow.	5	3	15	None	Include in monitoring at intake
Perfluorooctanoic acid (PFOA)	Y	Flame retardant - ubiquitous in surface waters.	5	3	15	Gate 3: Although no PCV exceedances of DWI Tier 3 guidance, risk likelihood to remain high to account for possible future legislation changes and to align with downstream SROs. (Culham intake average concentration 0.0022ug/l) Gate 2: No consequence score available in DWI guidance. Proposed standard in revision to Drinking Water standards =0.1ug/l.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	5	3	15	Difficult to control as widely present in environment. Not in existing DWSP - scores based on judgement - known high environmental levels	Continue to include in future monitoring and review	5	3	15	Likelihood risk carried over from Catchment stage	Difficult to control as present at all times Gate 3: Possible dilution effect of reservoir discharge during low periods of flow.	5	3	15	None	Include in monitoring at intake
Somatic coliphage	N*	Viruses derived from faecal contamination and sewage.	5	3	15	Gate 3: No change in Gate 2 likelihood score of 5 as Culham average concentration = 0.75 no/l, 95%ile 1.65 no/l, Datchet intake average concentration = 0.54 no/l, 95%ile=0.68no/l. No new data for Sunnymeads intake. Gate 2: Not included in pre-existing Thames DWSP.	Gate 3: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	5	3	15	Widely present in sewage. Scores based on judgement as not in existing DWSP.	None	5	3	15	Likelihood risk carried over from Catchment stage	Difficult to control as present at all times	5	3	15	None	Addressed at treatment stage.
Turbidity	Y	Derived from sediment transport from catchment. Some turbidity associated with algae.	3	5	15	Gate 3: No change in Gate 2 likelihood score of 3 as the Culham intake average concentration =12.67 NTU, 95%ile concentration = 17NTU, Datchet intake average concentration= 7.47 NTU, 95%ile concentration = 20.7 NTU, Sunnymeads intake average concentration= 7.42NTU, 95%ile concentration = 20.2 NTU. Gate 2: Consequence score aligned with DWI guidance after workshop.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	3	5	15	Inputs from many sources associated with sediment transport. Reservoir will reduce through settlement	None	3	5	15	Likelihood risk carried over from Catchment stage	Cease abstraction when turbidity high in reservoir	3	5	15	None	Include in monitoring at intake
Algae	Y	The River Thames support large populations of algae, particularly in the spring.	5	4	20	Gate 3: Reservoir also likely generate or increase present large algal populations. Not present in Thames DWSP. Affinity Water catchment DWSP at Walton and Egham give likelihood score of 5. Gate 2: Reservoir also likely generate large algal populations. Not included in pre-existing Thames DWSP No Drinking Water standards - affect on treatment main concern. No consequence score available in DWI guidance.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; eutrophication management in reservoir will reduce risk	5	4	20	Associated with elevated nutrient concentrations so will be managed in part by environmental regulations including WFD. Not included in existing DWSP so scores based in judgement.	Continue monitoring and review through the gated process.	5	4	20	Gate 3: Likelihood risk carried over from Catchment stage.	Gate 2: Potentially cease abstraction when key species present in large numbers. Design treatment works to cope with high levels of algae. Although growth will be encouraged in the reservoir mixing is provided in the reservoir to mitigate impacts. Reservoir modelling results indicate an increase in algal	5	4	20	Prediction of algal levels in the reservoir is difficult due to the high degree of uncertainty.	Continue monitoring at intake. Provide algal treatment at downstream abstraction WTWs.
Microcystin and other algal toxins	N*	Produced by cyanobacteria.	4	4	16	Gate 2: Not included in existing DWSP. No consequence score available in DWI guidance. Proposed standard in revision to Drinking Water standards = 1ug/l.	Gate 3: No change WQ response procedures. Gate 2:WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; eutrophication management in reservoir will reduce risk	4	4	16	Not included in existing DWSP so scores based on judgement. Reservoir primary source of risk.	Include in future monitoring and review	4	4	16	Likelihood risk carried over from Catchment stage	Cease abstraction when key species present	4	4	16	Prediction of algal levels in the reservoir is difficult due to the high degree of uncertainty.	Include in monitoring at intake
Metaldehyde	Y	Important pesticide as difficult to treat and high observed environmental levels.	3	2	6	Gate 3: Inclusion as a hard to treat pesticide despite usage ban. Decreased Gate 2 likelihood score from 4 to 3 as Culham intake data suggests it is largely below the limit of detection (<0.02ug/l). Risk likelihood score reflects Datchet Intake DWSP. Gate 2: Observed data shows moderate risk.	Gate 3: No change WQ response procedures. Gate 2: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; AMP funded solutions, management of abstraction to reservoir.	3	2	6	Existing problem at TWUTL treatments works -unlikely to be increased by SESRO. Included in existing monitoring on the River Thames	Review abstraction management	3	2	6	Likelihood risk carried over from Catchment stage	Catchment monitoring of pesticide use, dilution effect of the reservoir, potentially cease abstraction when concentrations high	3	2	6	Difficult to eliminate risk	Include in monitoring at intake
Aluminium	Y	Naturally occurring limiting hazard requiring removal. Likely to drive acceptability of water supply scheme by consumers further down the source to consumer tap pathway.	5	4	20	Gate 3: Inclusion as a natural compound requiring removal. When used as a coagulant dosing needs to be carefully controlled. average concentration= 121.4 ug/l, 95%ile concentration= 311 ug/l. WSR2016 limit is 200 µg/l. Risk score of 5 as there are multiple PCV breaches between 2020 &2023.	Gate 3: WQ Response Procedures & review process - RIC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication;	5	4	20	Existing problem at treatments works - unlikely to be increased by SESRO. Included in existing monitoring on the River Thames	Review abstraction management	5	4	20	Likelihood risk carried over from Catchment stage	Gate 3: Potential to reduce risk if cease abstraction from SESRO if reservoir concentrations high. Reservoir aeration will reduce release from sediments. Controls on abstraction to SESRO in response to pollution incident.	4	4	16	As largely natural origins difficult to mitigate against completely	Gate 3: Implications of not being able to abstract has implications on direct abstraction for T2ST and treatment implication. T2ST to consider designing for high aluminium concentrations. Include in monitoring at reservoir abstraction point.

SESRO | SESRO Thames River Thames Take and Put Option, Gate 3

Export to PDF

Note to user
Graphs do not auto colour to red, amber and green. Please right click each segment of the doughnut chart to manually change the colours.

Summary of SRO Risks

Catchment → Abstraction → Raw Water Conveyance → Treatment → Storage → Distribution → Consumer

RAG	Risk score	Hazard
Red	15	Iron
Red	15	Perfluoro octane sulfonate (PFOS)
Red	15	Perfluorooctanoic acid (PFOA)
Red	15	Somatic coliphage
Red	15	Turbidity
Red	15	Geosmin/2-Methylisoborneol (MIB)
Red	16	Hydrogen ion
Red	16	Microcystin and other algal toxins
Red	16	Odour
Red	16	Radioactivity(Alpha, Beta, Tritium)
Red	16	Taste
Red	20	Algae
Red	20	Aluminium
Red	20	Clostridium perfringens
Red	20	Cryptosporidium
Red	20	Pesticides
Red	20	Pesticides: total
Red	25	Coliform bacteria
Red	25	Enterococci
Red	25	Escherida Coli
Red	25	Pathogens - Bacteria, Viruses, Protozoa
Amber	6	1,4-dioxane
Amber	6	Alkalinity
Amber	6	Bisphenol
Amber	6	Bromide
Amber	6	Dissolved organic carbon
Amber	6	Metaldehyde
Amber	6	Nitrosamines
Amber	6	N-Nitrosodimethylamine (NDMA)
Amber	6	Total Organic Carbon (TOC)
Amber	6	Zooplankton
Amber	8	Clopyralid
Amber	8	Dirty/discoloured water
Amber	8	Orthophosphate
Amber	9	Endocrine disrupting compounds
Amber	9	Manganese
Amber	10	Chromium
Amber	10	Cyanide
Amber	10	Lead
Amber	10	Mercury
Amber	10	Nickel
Amber	10	Nitrate
Amber	10	Nitrite
Amber	12	Benzo(a)pyrene
Amber	12	benzo(b)fluoranthene
Amber	12	benzo(ghi)perylene
Amber	12	benzo(k)fluoranthene
Amber	12	beta - estradiol
Amber	12	indeno(1,2,3 -cd)pyrene
Amber	12	Invasive non native species (INNS)
Amber	12	Polycyclic aromatic hydrocarbon:
Amber	12	Total Suspended Solids (TSS)

RAG	Risk score	Hazard
Red	15	Perfluoro octane sulfonate (PFOS)
Red	15	Perfluorooctanoic acid (PFOA)
Red	15	Somatic coliphage
Red	15	Turbidity
Red	16	Aluminium
Red	16	Hydrogen ion
Red	16	Microcystin and other algal toxins
Red	16	Radioactivity(Alpha, Beta, Tritium)
Red	20	Algae
Red	20	Clostridium perfringens
Red	20	Cryptosporidium
Red	20	Odour
Red	20	Pesticides: total
Red	25	Coliform bacteria
Red	25	Enterococci
Red	25	Escherida Coli
Red	25	Pathogens - Bacteria, Viruses, Protozoa
Amber	6	Alkalinity
Amber	6	Bromide
Amber	6	Clopyralid
Amber	6	Dirty/discoloured water
Amber	6	Dissolved organic carbon
Amber	6	Endocrine disrupting compounds
Amber	6	Manganese
Amber	6	Metaldehyde
Amber	6	Nitrosamines
Amber	6	N-Nitrosodimethylamine (NDMA)
Amber	6	Total Organic Carbon (TOC)
Amber	8	Benzo(a)pyrene
Amber	8	benzo(b)fluoranthene
Amber	8	benzo(ghi)perylene
Amber	8	benzo(k)fluoranthene
Amber	8	indeno(1,2,3 -cd)pyrene
Amber	8	Orthophosphate
Amber	8	Polycyclic aromatic hydrocarbon:
Amber	9	Total Suspended Solids (TSS)
Amber	10	Chromium
Amber	10	Cyanide
Amber	10	Nitrite
Amber	12	beta - estradiol
Amber	12	Geosmin/2-Methylisoborneol (MIB)
Amber	12	Invasive non native species (INNS)
Amber	12	Iron
Amber	12	Odour
Amber	12	Taste

RAG	Risk score	Hazard

RAG	Risk score	Hazard

RAG	Risk score	Hazard

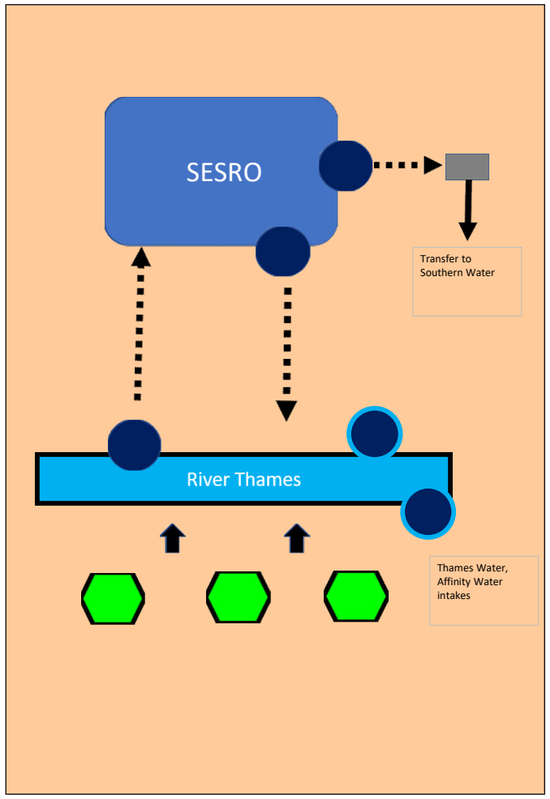
RAG	Risk score	Hazard

RAG	Risk Score	Hazard

SESRO **SESRO T2ST direct transfer, Gate 3**

SRO Schematic

Resposible Party	WSS Asset
Thames Water	*SESRO*



Insert Map or Schematic of SRO here

Key

Asset	New	Existing
Booster chlorination		
Catchment		
Canal		
Final Effluent Discharge		
Potable distribution		
Pumping Station		
Raw water abstraction		
Raw Water Conditioning Plant		
Raw water transfer		
River		
Treated water storage		
Treated water transfer		
Existing tie-in point		
Wastewater Treatment Works		

SESRO **SESRO T2ST direct transfer, Gate 3**

Catchment

Data source and certainty input (Hide / Open)	Limiting Hazard (Filter)	Parameter details and commentary	Pre-mitigated Likelihood	Pre-mitigated Consequences	Pre-mitigated Risk	Risk Commentary	Control	Post mitigated Likelihood	Post mitigated Consequences	Residual risk	Residual risk considerations	Actions
Escherichia Coli	Y	Faecal pathogens derived from sewage, livestock, human activity and wildlife in the catchment.	5	5	25	Gate 3: Likelihood score increased as multiple PCV breaches in the last year in accordance to ACWG methodology.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	5	5	25	Cannot be sufficiently reduced within the catchment to modify downstream actions. Reservoir will reduce risk but only in abstracted water. Mitigation primarily in treatment.	Gate 3: Consider moving the abstraction point upstream of Abingdon sewage discharge locations as mitigation.
Cryptosporidium	Y	Derived from livestock and sewage in the catchment. Spores can survive for a long time in the environment.	4	5	20	Gate 3: Inclusion as limiting hazard due to high residual risks and potential downstream treatment implications, as well as alignment with downstream SROs. PCV breached within the last 2 years in November 2022. Likelihood score confirmed as a 4 in workshop. Gate 2: Because of the health risk a consequence score of 5 has been applied	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	4	5	20	Cannot be sufficiently reduced within the catchment to modify downstream actions. Reservoir will reduce risk but only in abstracted water. Mitigation primarily in treatment.	None
Chromium	Y	Derived from industry and geology.	2	5	10	Gate 3: No change in Gate 2 likelihood score of 2 as at Datchet Intake average concentration= 0.65 ug/l, 95%ile concentration = 1.39 ug/l. Chromium VI - 1 instance of 27 ug/l in 2023. Gate 2: Observed data indicates low risk. Consequence aligned with DWI guidance following workshop.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, Customer Complaint Procedures, ERD for event actions & notification criteria; Operational standards & procedures with review process; controls on abstraction to SESRO in response to pollution incident	2	5	10	Medium Risk, difficult to mitigate in catchment.	None
Iron	Y	Primarily derived from geology. Sewage works can be an issue where iron dosing. Can be generated from reservoir sediment under low DO conditions.	5	3	15	Gate 3: Likelihood score increased from Gate 2 to a score of 5 following the ACWG methodology, as the Culham intake average concentration =176.12 ug/l, 95%ile concentration = 364 ug/l, Datchet Intake average concentration= 141.73 ug/l, 95%ile concentration = 314 ug/l with multiple PCV exceedances in the last year. Sunnymeads Intake average concentration= 143.14 ug/l, 95%ile concentration = 332 ug/l Gate 2: Added as limiting hazard after Gate 1 workshop. SRO monitoring shows concentrations above Drinking Water standard. Consequence aligned with DWI guidance following workshop.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; permitting at sewage works. Reservoir aeration will reduce release from sediments. Controls on abstraction to SESRO in response to pollution incident.	5	3	15	As largely natural origins difficult to mitigate against in catchment.	Review of sources of iron to assess whether any significant non geological sources
Manganese	Y	Primarily derived from geology. Can be generated from reservoir sediment under low DO conditions.	3	3	9	Gate 3: No change in Gate 2 likelihood score of 3 as the Culham intake average concentration =12 ug/l, 95%ile concentration = 17.8 ug/l, Datchet Intake average concentration= 10.62 ug/l, 95%ile concentration = 16.1 ug/l, Sunnymeads Intake average concentration= 10.96 ug/l, 95%ile concentration = 18.2 ug/l Gate 2: SRO monitoring shows concentration in River Thames above Drinking Water standard. Consequence aligned with DWI guidance following workshop.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; reservoir aeration will reduce risk of release from sediment. Controls on abstraction to SESRO in response to pollution incident.	3	3	9	As largely natural origins difficult to mitigate against in catchment.	None
Bromate	Y	Derived from geology and industry and generated from bromide in water treatment.	1	5	5	Gate 3: No change in Gate 2 likelihood score of 1 as the Culham intake average concentration =0.85ug/l, 95%ile concentration = 1 ug/l, Datchet Intake average concentration= 0.558 ug/l, 95%ile concentration =1 ug/l. Gate 2: Observed data indicates low risk from catchment. Consequence aligned with DWI guidance following workshop. Confirmation with workshop attendees on severity of scoring.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans;	1	5	5	None	None
Nitrate	Y	Mainly derived from agriculture, atmospheric deposition and sewage.	2	5	10	Gate 3: No change in Gate 2 likelihood score of 2 as the Culham intake average concentration =20.32mg/l, 95%ile concentration = 41.2mg/l, Datchet Intake average concentration= 30.47 ug/l, 95%ile concentration = 36.2 ug/l, Sunnymeads Intake average concentration= 27.67g/l, 95%ile concentration = 36.4 ug/l. Modelling shows average Nitrate at the intake for a 4 year drought event as 7.23mg/l and for a 2 year drought event as 6.57mg/l. Gate 2: Storage will tend to reduce risk because of denitrification. Consequence aligned with DWI guidance following workshop.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans; reservoir storage will reduce risk	2	5	10	Ongoing catchment measures and changes in agriculture may modify risks in the future	None
Nitrite	Y	Derived from nitrogen sources in the catchment and sewage as well as low dissolved oxygen and reducing conditions. May also be produced in reservoir or distribution if low dissolved oxygen concentrations prevail.	5	2	10	Gate 3: Gate 2 likelihood score of 2 increased to 5 as the Culham intake average concentration =0.21mg/l, 95%ile concentration = 0.88mg/l, Datchet Intake average concentration= 0.185 mg/l, 95%ile concentration = 0.75mg/l, Sunnymeads Intake average concentration= 0.3 mg/l, 95%ile concentration = 0.92 mg/l. Likelihood score increased to a 5 in workshop. Gate 2: Observed data shows high concentrations in River Thames above PCV. Consequence aligned with DWI guidance following workshop.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; reservoir process will convert to nitrate at most times; aeration would reduce the risk of generation in the reservoir. Reduce abstraction if river concentrations high.	5	2	10	Source difficult to mitigate as environmentally dynamic	Review sources and processes at next stage of the DWQRA.
Pesticides total	Y	Derived from agricultural and amenity applications of pesticides in the catchment. (Including propyzamide, mecoprop, MCPA, glyphosate, fluroxypyr, flufenacet, dicofol, clopyralid, carbetamide, bentazone, 2,4-dichlorophenoxyacetic acid (2,4-D))	5	4	20	Gate 3: PCV exceedances for multiple pesticides in the catchment throughout the last two years. No change in Gate 2 likelihood score of 5. Intake modelling does not consider Pesticides, however total phosphorous and orthophosphate is included in the modelling. Gate 2: Consequence aligned with DWI guidance following workshop. This downgrades risk category.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans; AMP funded solution; Controls on abstraction to SESRO in response to pollution incident.	5	4	20	Ongoing catchment measures and changes in agriculture and industry may modify risks in the future. Reservoir storage will reduce risk in component abstracted to reservoir but may return loads to river in summer	Review catchment measures and new pesticides when they become available and/or their usage changes. Include in water quality modelling work. Process to review emerging pesticides and change in usage
Polycyclic aromatic hydrocarbon	N*	Associated with hydrocarbon and fossil fuel usage. Observed data indicates high risk. Consequence aligned with DWI guidance following workshop.	3	4	12	Gate 3: No change in Gate 2 likelihood score of 3 as the Culham intake average benzo(b)fluoranthene concentration = 0.004ug/l, 95%ile concentration = 0.009ug/l, benzo(k)fluoranthene average concentration= 0.002ug/l, 95%ile concentration = 0.005ug/l, benzo(ghi)perylene average concentration= 0.004ug/l, 95%ile concentration = 0.01 ug/l, indeno[1,2,3-cd]pyrene average concentration = 0.004ug/l, 95%ile=0.011ug/l Gate 2: Observed data indicates high risk. Consequence aligned with DWI guidance following workshop.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans; Controls on abstraction to SESRO in response to pollution incident.;	3	4	12	Generally at low background level but can be increased by pollution events, Reservoir will even out peaks.	None
Benzo(a)pyrene	N*	Associated with hydrocarbon and fossil fuel usage. Observed data indicates moderate to high risk.	3	4	12	Gate 3: No change in Gate 2 likelihood score of 3 as the Culham intake average concentration = 0.003ug/l, 95%ile concentration = 0.01ug/l, Datchet intake average concentration= 0.005ug/l, 95%ile concentration = 0.01ug/l, Sunnymeads intake average concentration= 0.007ug/l, 95%ile concentration = 0.018ug/l. Gate 2: Observed data indicates moderate to high risk.	WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans; Controls on abstraction to SESRO in response to pollution incident.	3	4	12	Controls on abstraction to SESRO in response to pollution incident. Reservoir will even out peaks.	Not highlighted as a limiting hazard for SESRO at this stage of the DWQRA. Review the need to include as limiting hazard at the next stage and align with other SRO considerations downstream.
Dirty/discoloured water	Y	Present in natural waters	4	2	8	Gate 3: No change in Gate 2 likelihood score of 4 as the Culham intake average concentration =11.1 Hazen, 95%ile concentration =21.95 Hazen. Gate 2: Not included in existing DWSP	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans;	4	2	8	Need to investigate specific causes if discoloration occurs	None
Odour	Y	Mainly derived from biological activity in the catchment, River Thames and reservoir.	4	4	16	Gate 3: No change in Gate 2 risk likelihood of 4. Gate 2: No consequence score available in DWI guidance.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; eutrophication management will reduce risk of odour generation in the reservoir	4	4	16	As largely of natural origin and derived from many sources, it is difficult to mitigate against. Scores based on judgement as not included in existing DWSP.	Additional monitoring to determine if odour is an issue.
Taste	Y	Mainly derived from biological activity in the catchment, River Thames and reservoir.	4	4	16	Gate 3: No change in Gate 2 risk likelihood of 4. No new updated data from Gate 2. Gate 2: No consequence score available in DWI guidance.	Gate 3: No change to WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; eutrophication management should reduce risk of generation in the reservoir	4	4	16	As largely of natural origin and derived from many sources, it is difficult to mitigate against. Scores based on judgement as not included in existing DWSP.	Additional monitoring to determine if odour is an issue.
Change in source type (e.g. surface - groundwater)	Y	Surface water remains the only source.	2	1	2	Gate 3: As Gate 2 low risk for SESRO SRO as the source remains the same, however, downstream SROs will need to include treatment and Stakeholder engagement as control measures to reduce risk to consumers. Gate 2: Not included in existing DWSP. However, for downstream SROs that do not currently have the River Thames as a water source or utilise groundwater sources, this will cause a change in source.	None	2	1	2	Not included in existing DWSP so risk scores based on judgement.	Further downstream SROs to include risk of changing water source in DWSPs. Include in future monitoring and review.
Pathogens - *Bacteria, Viruses, Protozoa*	Y	Derived from sewage, livestock, human activity and wildlife.	5	5	25	Gate 3: Limiting hazard for viruses. Not included at Gate 2 but have been included both in STT and T2ST as an indicator of human and sewage activity due to population located around the river. Not expected to be limiting in needing additional control measures – potentially cause treatment problems if treatment isn't extensive enough leading to impacts on human health.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans; storage will tend to reduce risk in water pumped to reservoir	5	5	25	Derived from numerous largely uncontrollable sources in the catchment. Reservoir will reduce risk because of natural losses of pathogens in storage. However due to the high degree of uncertainty the likelihood score has not been changed to reflect a high risk and to address concerns at downstream water treatment works.	None
Invasive non native species (INNS)	Y	No new sources of water associated with SESRO so no particular risk from invasive species.	4	4	16	Gate 3: Potential sources of INNS through recreation activities around the reservoir. Gate 2: Relevant to transfer of water downstream. Not included in existing DWSP	Gate 3: Screens at inlet into the reservoir, visitor awareness and controls on water sports within the reservoir and surrounding area. Gate 2: Specific controls need to be developed for INNS	3	4	12	Covered by INNS analysis in SESRO EAR	NA
Ammonium	N*	Derived from sewage, livestock and general biological activity in catchments. No Drinking Water Standard. Consequence scores aligned with DWI guidance.	4	1	4	Gate 3: No change in Gate 2 likelihood score of 4 as the Culham intake average concentration for ammoniacal N = 0.155mg/l, 95%ile concentration = 0.71mg/l, Datchet intake average concentration= 0.084mg/l, 95%ile concentration = 0.167mg/l, Sunnymeads intake average concentration= 0.085mg/l, 95%ile concentration = 0.268mg/l. Gate 2: No Drinking Water Standard. Consequence scores aligned with DWI guidance.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication; Designated SGZs in catchment with associated action plans.	4	1	4	Ammonia concentrations in the River Thames are addressed by asset management to address environmental regulations including WFD. Can be generated through reservoir processes.	None
Radioactivity(Alpha, Beta, Tritium)	N*	Determined by natural geological radioactivity. Observed data shows significant risk. Consequence score aligned with DWI guidance after workshop. Described as a screening value rather than an issue per se.	4	4	16	Gate 3: Observed data shows presence. Flagged as for alpha activity at Datchet the 1st Q's above the WSR2016 PCV of 0.1 Bq/l. Not highlighted as a limiting hazard for SESRO during the workshop. Review the need to include as limiting hazard at the next stage and align with other SRO considerations downstream. Gate 2: Observed data shows significant risk. Consequence score aligned with DWI guidance after workshop. Described as a screening value rather than an issue per se.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Controls on abstraction to SESRO in response to pollution incident.;	4	4	16	Difficult to modify risk because determined by natural geological sources.	Not highlighted as a limiting hazard for SESRO at this stage of the DWQRA. Review the need to include as limiting hazard at the next stage and align with other SRO considerations downstream.
Chlorate	Y	Disinfection by-product - only relevant in treatment and distribution. No consequence score available in DWI guidance. Included as a limiting hazard to align with downstream SRO options.	1	3	3	Gate 3: No change in Gate 2 likelihood score of 2 as observed data indicates low risk (is at limit of detection) for Culham, Datchet intake. No new data for Sunnymeads. Gate 2: No consequence score available in DWI guidance.	Not applicable at catchment stage.	1	3	3	NA	None
beta - estradiol	N*	Derived from industrial and domestic chemical usage. Environmental levels tend to be high.	3	4	12	Gate 3: No change in Gate 2 likelihood score of 3 as there is no new observed data for Culham, Datchet, Sunnymeads intakes. Gate 2: Not included in pre-existing Thames DWSP. No Drinking Water Standard. No consequence score available in DWI guidance. Proposed watchlist standard in revision of Drinking Water standards = 0.001 ug/l.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	3	4	12	Difficult to control as related to many individual usages of chemicals. Not in existing DWSP - scores based on judgement	Include in future monitoring and review
Perfluorooctane sulfonate (PFOS)	Y	Flame retardant - ubiquitous in surface waters.	5	5	25	Gate 3: Although no PCV exceedances of DWI Tier 3 guidance in Atkins monitoring suite, risk likelihood to remain high to account for possible future legislation changes and to align with downstream SROs. TW Datchet intake DWSP (Total PFOS <0.01ug/l on 2 occasions: 0.0161ug/l, 01/04/2022 and 0.0142ug/l, 01/07/2022). Gate 2: Not included in existing DWSP. No consequence score available in DWI guidance. Proposed standard in revision to Drinking Water standards = 0.1ug/l.	Gate 3: As per Gate 2 WQ response procedures. Thames Water Datchet intake (2022) includes a watching brief is to be maintained as water quality sampling indicates potential raw water contamination from the source. Stakeholder engagement with firefighters on current and future use. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	5	5	25	Gate 3: Difficult to control as widely present in environment without substance control use. Included in updated DWSPs. Gate 2: Difficult to control as widely present in environment. Not in existing DWSP - scores based on judgement - known high environmental levels	Continue to include in future monitoring and review
Perfluorooctanoic acid (PFOA)	Y	Flame retardant - ubiquitous in surface waters.	5	5	25	Gate 3: Although no PCV exceedances of DWI Tier 3 guidance, risk likelihood to remain high to account for possible future legislation changes and to align with downstream SROs. (Culham intake average concentration 0.0022ug/l) Gate 2: No consequence score available in DWI guidance. Proposed standard in revision to Drinking Water standards = 0.1ug/l.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	5	5	25	Difficult to control as widely present in environment. Not in existing DWSP - scores based on judgement - known high environmental levels	Continue to include in future monitoring and review
Somatic coliphage	N*	Viruses derived from faecal contamination and sewage.	5	3	15	Gate 3: No change in Gate 2 likelihood score of 5 as Culham average concentration = 0.75 no/l, 95%ile 1.85 no/l, Datchet intake average concentration = 0.54 no/l, 95%ile=0.68no/l. No new data for Sunnymeads intake. Gate 2: Not included in pre-existing Thames DWSP.	Gate 3: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	5	3	15	Widely present in sewage. Scores based on judgement as not in existing DWSP.	None
Turbidity	Y	Derived from sediment transport from catchment. Some turbidity associated with algae.	3	5	15	Gate 3: No change in Gate 2 likelihood score of 3 as the Culham intake average concentration =12.67 NTU, 95%ile concentration = 17NTU, Datchet intake average concentration= 7.47 NTU, 95%ile concentration = 20.7 NTU, Sunnymeads intake average concentration= 7.42NTU, 95%ile concentration = 20.2 NTU. Gate 2: Consequence score aligned with DWI guidance after workshop.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process;	3	5	15	Inputs from many sources associated with sediment transport. Reservoir will reduce through settlement	None
Algae	Y	The River Thames support large populations of algae, particularly in the spring.	5	4	20	Gate 3: Reservoir also likely generate or increase present large algal populations. Not present in Thames DWSP. Affinity Water catchment DWSP at Walton and Egham give likelihood score of 5. Gate 2: Reservoir also likely generate large algal populations. Not included in pre-existing Thames DWSP. No Drinking Water standards - affect on treatment main concern. No consequence score available in DWI guidance.	Gate 3: No change in WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; eutrophication management in reservoir will reduce risk	5	4	20	Associated with elevated nutrient concentrations so will be managed in part by environmental regulations including WFD. Not included in existing DWSP so scores based in judgement.	Include in future monitoring and review Analyse CEH data - liaise with Atkins.
Microcystin and other algal toxins	N*	Produced by cyanobacteria.	4	4	16	Gate 2: Not included in existing DWSP. No consequence score available in DWI guidance. Proposed standard in revision to Drinking Water standards = 1ug/l.	Gate 3: No change WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; eutrophication management in reservoir will reduce risk	4	4	16	Not included in existing DWSP so scores based on judgement. Reservoir primary source of risk.	Include in future monitoring and review
Metaldehyde	Y	Important pesticide as difficult to treat and high observed environmental levels.	3	2	6	Gate 3: Inclusion as a hard to treat pesticide despite usage ban. Decreased Gate 2 likelihood score from 4 to 3 as Culham intake data suggests it is largely below the limit of detection (<0.02ug/l). Risk likelihood score reflects Datchet intake DWSP. Gate 2: Observed data shows moderate risk.	Gate 3: No change WQ response procedures. Gate 2: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; AMP funded solutions, management of abstraction to reservoir.	3	2	6	Existing problem at TWUTL treatments works - unlikely to be increased by SESRO. Included in existing monitoring on the River Thames	Review abstraction management
Aluminium	Y	Naturally occurring limiting hazard requiring removal. Likely to drive acceptability of water supply scheme by consumers further down the source to consumer tap pathway.	5	4	20	Gate 3: Inclusion as a natural compound requiring removal. When used as a coagulant dosing needs to be carefully controlled. average concentration= 121.4 ug/l, 95%ile concentration= 312 ug/l. WSR2016 limit is 200 µg/l. Risk score of 5 as there are multiple PCV breaches between 2020 &2023.	Gate 3: WQ Response Procedures & review process - RtC for investigation of contraventions, process optimisation & reporting - Customer Complaint Procedures - ERD for event actions & notification criteria; Operational standards & procedures with review process; Stakeholder communication;	5	4	20	Existing problem at treatments works - unlikely to be increased by SESRO. Included in existing monitoring on the River Thames	Review abstraction management

Abstraction (Reservoir)

Data source and certainty input	Pre-mitigated Likelihood	Pre-mitigated Consequences	Pre-mitigated Risk	Risk Commentary	Control	Post mitigated Likelihood	Post mitigated Consequences	Residual risk	Residual risk considerations	Actions
Escherichia Coli	5	5	25	Likelihood risk carried over from Catchment stage	Little scope to control at the abstraction point as present at all times	5	5	25	None	None
Cryptosporidium	4	5	20	Likelihood risk carried over from Catchment stage. Likelihood score confirmed as a 4 in workshop.	Gate 3: Possible sedimentation of cryptosporidium. Gate 2: Controls of abstraction would help during periods of high loads with river turbidity high.	4	5	20	Risk cannot be sufficiently reduced in the reservoir/abstraction to modify treatment requirements downstream. Likelihood score confirmed as a 4 in workshop.	Review abstraction strategy in relation to Cryptosporidium risk at intakes
Chromium	2	5	10	Likelihood risk carried over from Catchment stage	Cease abstraction of concentrations in reservoir high	2	5	10	None	None
Iron	5	3	15	Likelihood risk carried over from Catchment stage	Gate 3: Potential to reduce risk if cease abstraction from SESRO if reservoir concentrations high. Reservoir aeration will reduce release from sediments. Controls on abstraction to SESRO in response to pollution incident.	4	3	12	As largely natural origins difficult to mitigate against completely	Gate 3: Not being able to abstract from SESRO during periods of refilling the reservoir impacts the direct abstraction of T2ST. High iron concentrations can also impact treatment train. T2ST design team to consider designing the WTWs to cope with high iron concentrations. Gate 2: Include in monitoring at reservoir abstraction point.
Manganese	3	3	9	Likelihood risk carried over from Catchment stage	Gate 3: Potential to reduce risk if cease abstraction from SESRO if reservoir concentrations high.	2	3	6	As largely natural origins difficult to mitigate against completely	Include in monitoring at reservoir abstraction point
Bromate	1	5	5	Likelihood risk carried over from Catchment stage	None required	1	5	5	Risk associated with oxidation of bromide during treatment	None
Nitrate	2	5	10	Likelihood risk carried over from Catchment stage, modelling shows low risk of nitrate with an average of 3.38mg/l and 3.40mg/l for a 4 year and 2 year drought event respectively.	Gate 3: Inlet jet system and bubble aerators, recirculation pumps	2	5	10	Impossible to eliminate risk as present at all times	None
Nitrite	5	2	10	Likelihood risk carried over from Catchment stage	Gate 3: Inlet jet system and bubble aerators, recirculation pumps	5	2	10	Impossible to eliminate risk as present at all times	Include in monitoring at abstraction point from reservoir Precedent in LTR on score reduction across reservoir. Water modelling access.
Pesticides total	5	4	20	Likelihood risk carried over from Catchment stage	Catchment monitoring of pesticide use, dilution effect of the reservoir, potentially cease abstraction when concentrations high.	5	4	20	Gate 3: In addition to Gate 2 , the treatment process for T2ST design currently includes GAC to mitigate risk downstream. Gate 2: Requires frequent monitoring and immediate response	Include in monitoring at intake
Polycyclic aromatic hydrocarbon	3	4	12	Likelihood risk carried over from Catchment stage	Controls on abstraction to SESRO in response to pollution incident.	2	4	8	Remaining risk low to moderate	None
Benzo(a)pyrene	3	4	12	Likelihood risk carried over from Catchment stage	Gate 3: No change since gate 2 Gate 2: Possible dilution effect	2	4	8	None	None
Dirty/discoloured water	4	2	8	Likelihood risk carried over from Catchment stage	Cease abstraction when water highly discoloured	3	2	6	Can lower risk but not eliminate	Include in monitoring at intake
Odour	4	4	16	Likelihood risk carried over from Catchment stage	Difficult to control as present in water source, potentially cease abstraction should parameters affecting odour e.g. algae persist.	3	4	12	Can lower risk but not eliminate	Include in monitoring at intake
Taste	4	4	16	Likelihood risk carried over from Catchment stage	Difficult to control as present in water source, potentially cease abstraction should parameters affecting taste e.g. high iron concentrations, geosmin etc. persist.	3	4	12	Can lower risk but not eliminate	Include in monitoring at intake
Change in source type (e.g. surface - groundwater)	2	1	2	Likelihood risk carried over from Catchment stage	None required	2	1	2	Not included in existing DWSP so risk scores based on judgement.	Pass information on to T2ST on risk of changing sources.
Pathogens - *Bacteria, Viruses, Protozoa*	5	5	25	Likelihood risk carried over from Catchment stage	Little option to control at the abstraction point as present at all times	5	5	25	Difficult to control at intake as level unpredictable and fast response impractical	None
Invasive non native species (INNS)	3	4	12	Likelihood risk carried over from Catchment stage	Gate 3: Covered by INNS analysis in SESRO. WTWs within SESRO boundary to reduce the risk of INNS between different catchments.	3	4	12	None	Understand activities surrounding the reservoir to better quantify risk at the next stage.
Ammonium	4	1	4	Likelihood risk carried over from Catchment stage	Gate 3: Dilution in the reservoir might attenuate impact on downstream treatment. Difficult to control as present at all times.	4	1	4	None	Challenging for potential downstream treatment.
Radioactivity(Alpha, Beta, Tritium)	4	4	16	Likelihood risk carried over from Catchment stage	None required	4	4	16	None	None
Chlorate	1	3	3	Likelihood risk carried over from Catchment stage	None required	1	3	3	None	None
beta - estradiol	3	4	12	Likelihood risk carried over from Catchment stage	Cease abstraction if concentrations high	3	4	12	None	Include in monitoring at intake
Perfluorooctane sulfonate (PFOS)	5	5	25	Likelihood risk carried over from Catchment stage	Difficult to control as present at all times Gate 3: Possible dilution effect of reservoir discharge during low periods of flow.	5	5	25	None	Include in monitoring at intake
Perfluorooctanoic acid (PFOA)	5	5	25	Likelihood risk carried over from Catchment stage	Difficult to control as present at all times Gate 3: Possible dilution effect of reservoir discharge during low periods of flow.	5	5	25	None	Include in monitoring at intake
Somatic coliphage	5	3	15	Likelihood risk carried over from Catchment stage	Difficult to control as present at all times	5	3	15	None	Addressed at treatment stage.
Turbidity	3	5	15	Likelihood risk carried over from Catchment stage	Cease abstraction when turbidity high in reservoir	3	5	15	None	Include in monitoring at intake
Algae	5	4	20	Gate 3: Likelihood risk carried over from Catchment stage.	Gate 3: Potentially cease abstraction when key species present in large numbers. Design treatment works to cope with high levels of algae. Although growth will be encouraged in the reservoir mixing is provided in the reservoir to mitigate impacts. Reservoir modelling results indicate an increase in algal growth when reservoir is filled. Algae present begins to decline as nutrients in reservoir decline.	5	4	20	Prediction of algal levels in the reservoir is difficult due to the high degree of uncertainty.	Continue monitoring at intake. Provide algal treatment at downstream abstraction WTWs.
Microcystin and other algal toxins	4	4	16	Likelihood risk carried over from Catchment stage	Cease abstraction when key species present	4	4	16	Prediction of algal levels in the reservoir is difficult due to the high degree of uncertainty.	Include in monitoring at intake
Metaldehyde	3	2	6	Likelihood risk carried over from Catchment stage	Catchment monitoring of pesticide use, dilution effect of the reservoir, potentially cease abstraction when concentrations high	3	2	6	Difficult to eliminate risk	Include in monitoring at intake
Aluminium	5	4	20	Likelihood risk carried over from Catchment stage	Gate 3: Potential to reduce risk if cease abstraction from SESRO if reservoir concentrations high. Reservoir aeration will reduce release from sediments. Controls on abstraction to SESRO in response to pollution incident.	4	4	16	As largely natural origins difficult to mitigate against completely	Gate 3: Implications of not being able to abstract has implications on direct abstraction for T2ST and treatment implication. T2ST to consider designing for high aluminium concentrations. Include in monitoring at from reservoir abstraction point.

Raw water conveyance (to T2ST WTWs)

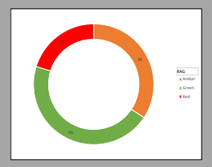
Data source and certainty input	Pre-mitigated Likelihood	Pre-mitigated Consequences	Pre-mitigated Risk	Risk Commentary	Control	Post mitigated Likelihood	Post mitigated Consequences	Residual risk	Residual risk considerations	Actions
Escherichia Coli	5	5	25	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	5	5	25	None	None
Cryptosporidium	4	5	20	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	4	5	20	None	None
Chromium	2	5	10	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	2	5	10	None	None
Iron	4	3	12	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	4	3	12	None	Gate 3: Not being able to abstract from SESRO during periods of refilling the reservoir impacts the direct abstraction of T2ST. High iron concentrations can also impact treatment train. T2ST design team to consider designing the WTWs to cope with high iron concentrations. Gate 2: Include in monitoring at reservoir abstraction point.
Manganese	2	3	6	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	2	3	6	None	None
Bromate	1	5	5	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	1	5	5	None	None
Nitrate	2	5	10	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	2	5	10	None	None
Nitrite	5	2	10	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	5	2	10	None	None
Pesticides total	5	4	20	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	5	4	20	None	None
Polycyclic aromatic hydrocarbon	3	4	12	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	2	4	8	None	None
Benzo(a)pyrene	3	4	12	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	2	4	8	None	None
Dirty/discoloured water	4	2	8	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	3	2	6	None	None
Odour	4	4	16	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	3	4	12	None	None
Taste	4	4	16	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	3	4	12	None	None
Change in source type (e.g. surface - groundwater)	2	1	2	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	2	1	2	None	None
Pathogens - *Bacteria, Viruses, Protozoa*	5	5	25	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	5	5	25	None	None
Invasive non native species (INNS)	3	4	12	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	3	4	12	None	None
Ammonium	4	1	4	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	4	1	4	None	None
Radioactivity(Alpha, Beta, Tritium)	4	4	16	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	4	4	16	None	None
Chlorate	1	3	3	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	1	3	3	None	None
beta - estradiol	3	4	12	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	3	4	12	None	None
Perfluorooctane sulfonate (PFOS)	5	5	25	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	5	5	25	None	None
Perfluorooctanoic acid (PFOA)	5	5	25	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	5	5	25	None	None
Somatic coliphage	5	3	15	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	5	3	15	None	None
Turbidity	3	5	15	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	3	5	15	None	None
Algae	5	4	20	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	5	4	20	None	None
Microcystin and other algal toxins	4	4	16	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	4	4	16	None	None
Metaldehyde	3	2	6	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	3	2	6	None	None
Aluminium	4	4	16	Likelihood risk carried over from abstraction stage.	Little scope to control during conveyance as present at all times	4	4	16	None	None

Export to PDF

Note to user
Graphs do not auto colour to red, amber and green. Please right click each segment of the doughnut chart to manually change the colours.

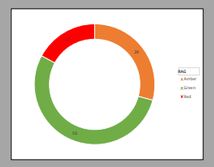
Summary of SRO Risks

Catchment



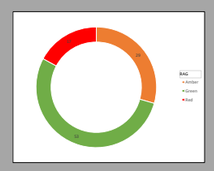
RAG	Risk score	Hazard
Red	15	Iron
Red	15	Somatic coliphage
Red	15	Turbidity
		Geosmin/2-Methylisoborneol
Red	16	(MIB)
Red	16	Hydrogen ion
Red	16	Microcystin and other algal toxins
Red	16	Odour
Red	16	Radioactivity(Alpha, Beta, Tritium)
Red	16	Taste
Red	20	Algae
Red	20	Aluminium
Red	20	Clostridium perfringens
Red	20	Cryptosporidium
Red	20	Pesticides: total
Red	25	Coliform bacteria
Red	25	Enterococci
Red	25	Escherida Coli
		Pathogens - Bacteria, Viruses,
Red	25	Protozoa
Red	25	Perfluorooctane sulfonate (PFOS)
Red	25	Perfluorooctanoic acid (PFOA)
Amber	6	1,4-dioxane
Amber	6	Alkalinity
Amber	6	bisphenol
Amber	6	Bromide
Amber	6	Dissolved organic carbon
Amber	6	Metaldehyde
Amber	6	Nitrosamines
Amber	6	N-Nitrosodimethylamine (NDMA)
Amber	6	Total Organic Carbon (TOC)
Amber	6	Zooplankton
Amber	8	Clopyralid
Amber	8	Dirty/discoloured water
Amber	8	Orthophosphate
Amber	9	Endocrine disrupting compounds
Amber	9	Manganese
Amber	10	Chromium
Amber	10	Cyanide
Amber	10	Lead
Amber	10	Mercury
Amber	10	Nickel
Amber	10	Nitrate
Amber	10	Nitrite
Amber	10	Pesticides
Amber	12	Benzo(a)pyrene
Amber	12	benzo(b)fluoranthene
Amber	12	benzo(ghi)perylene
Amber	12	benzo(k)fluoranthene
Amber	12	beta - estradiol
Amber	12	indeno(1,2,3 -cd)pyrene
Amber	12	Invasive non native species (INNS)
Amber	12	Polycyclic aromatic hydrocarbon:
Amber	12	Total Suspended Solids (TSS)

Abstraction



RAG	Risk score	Hazard
Red	15	Somatic coliphage
Red	15	Turbidity
Red	16	Aluminium
Red	16	Hydrogen ion
Red	16	Microcystin and other algal toxins
Red	16	Radioactivity(Alpha, Beta, Tritium)
Red	20	Algae
Red	20	Clostridium perfringens
Red	20	Cryptosporidium
Red	20	Pesticides
Red	20	Pesticides: total
Red	25	Coliform bacteria
Red	25	Enterococci
Red	25	Escherida Coli
		Pathogens - Bacteria, Viruses,
Red	25	Protozoa
Red	25	Perfluorooctane sulfonate (PFOS)
Red	25	Perfluorooctanoic acid (PFOA)
Amber	6	Alkalinity
Amber	6	Bromide
Amber	6	Clopyralid
Amber	6	Dirty/discoloured water
Amber	6	Dissolved organic carbon
Amber	6	Endocrine disrupting compounds
Amber	6	Manganese
Amber	6	Metaldehyde
Amber	6	Nitrosamines
Amber	6	N-Nitrosodimethylamine (NDMA)
Amber	6	Total Organic Carbon (TOC)
Amber	8	Benzo(a)pyrene
Amber	8	benzo(b)fluoranthene
Amber	8	benzo(ghi)perylene
Amber	8	benzo(k)fluoranthene
Amber	8	indeno(1,2,3 -cd)pyrene
Amber	8	Orthophosphate
Amber	8	Polycyclic aromatic hydrocarbon:
Amber	9	Total Suspended Solids (TSS)
Amber	10	Chromium
Amber	10	Nitrate
Amber	10	Nitrite
Amber	12	beta - estradiol
		Geosmin/2-Methylisoborneol
Amber	12	(MIB)
Amber	12	Invasive non native species (INNS)
Amber	12	Iron
Amber	12	Odour
Amber	12	Taste

Raw Water Conveyance



RAG	Risk score	Hazard
Red	15	Somatic coliphage
Red	15	Turbidity
Red	16	Aluminium
Red	16	Hydrogen ion
Red	16	Microcystin and other algal toxins
Red	16	Radioactivity(Alpha, Beta, Tritium)
Red	20	Algae
Red	20	Clostridium perfringens
Red	20	Cryptosporidium
Red	20	Pesticides
Red	20	Pesticides: total
Red	25	Coliform bacteria
Red	25	Enterococci
Red	25	Escherida Coli
		Pathogens - Bacteria, Viruses,
Red	25	Protozoa
Red	25	Perfluorooctane sulfonate (PFOS)
Red	25	Perfluorooctanoic acid (PFOA)
Amber	6	Alkalinity
Amber	6	Bromide
Amber	6	Clopyralid
Amber	6	Dirty/discoloured water
Amber	6	Dissolved organic carbon
Amber	6	Endocrine disrupting compounds
Amber	6	Manganese
Amber	6	Metaldehyde
Amber	6	Nitrosamines
Amber	6	N-Nitrosodimethylamine (NDMA)
Amber	6	Total Organic Carbon (TOC)
Amber	8	Benzo(a)pyrene
Amber	8	benzo(b)fluoranthene
Amber	8	benzo(ghi)perylene
Amber	8	benzo(k)fluoranthene
Amber	8	indeno(1,2,3 -cd)pyrene
Amber	8	Orthophosphate
Amber	8	Polycyclic aromatic hydrocarbon:
Amber	9	Total Suspended Solids (TSS)
Amber	10	Chromium
Amber	10	Nitrate
Amber	10	Nitrite
Amber	12	beta - estradiol
		Geosmin/2-Methylisoborneol
Amber	12	(MIB)
Amber	12	Invasive non native species (INNS)
Amber	12	Iron
Amber	12	Odour
Amber	12	Taste

Treatment

RAG	Risk Score	Hazard

Storage

RAG	Risk score	Hazard

Distribution

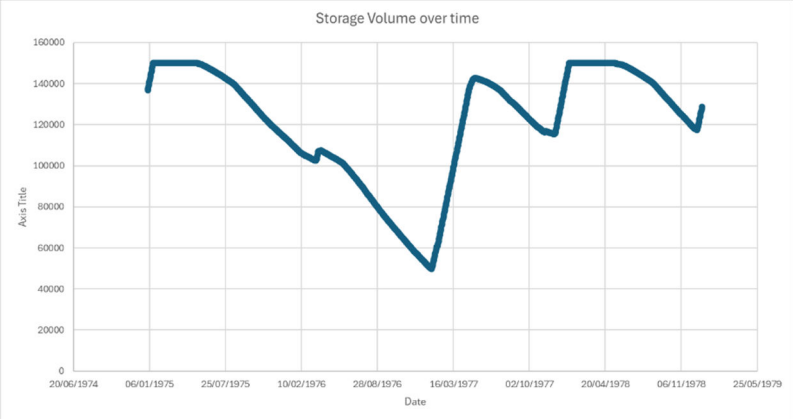
RAG	Risk score	Hazard

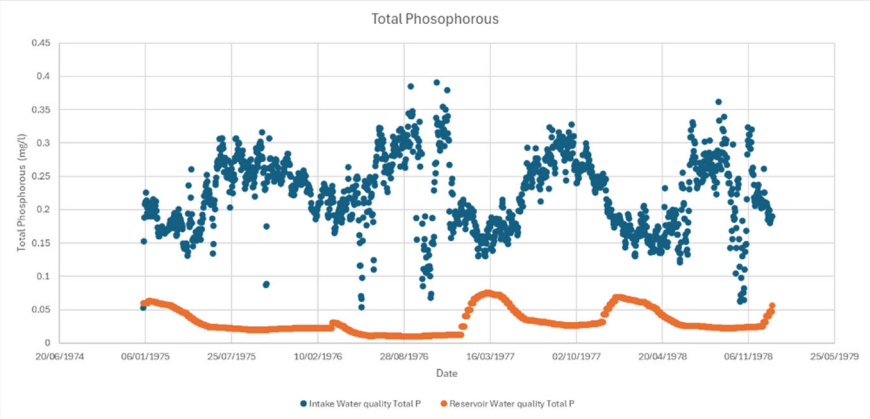
Consumer

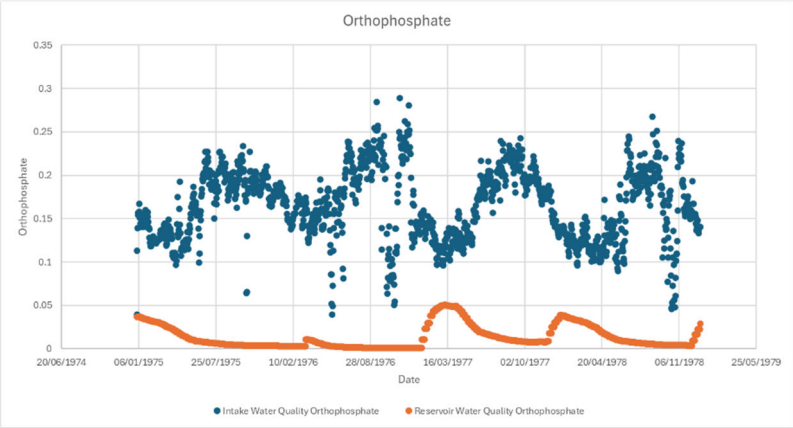
RAG	Risk Score	Hazard

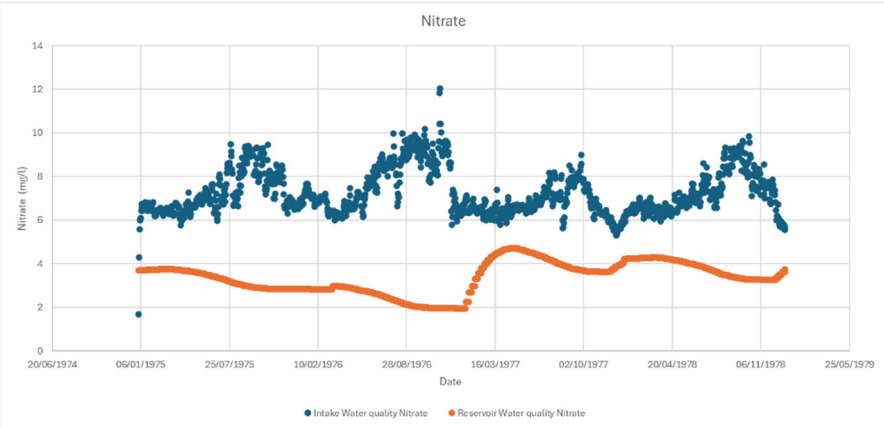
Appendix C – SESRO model outputs

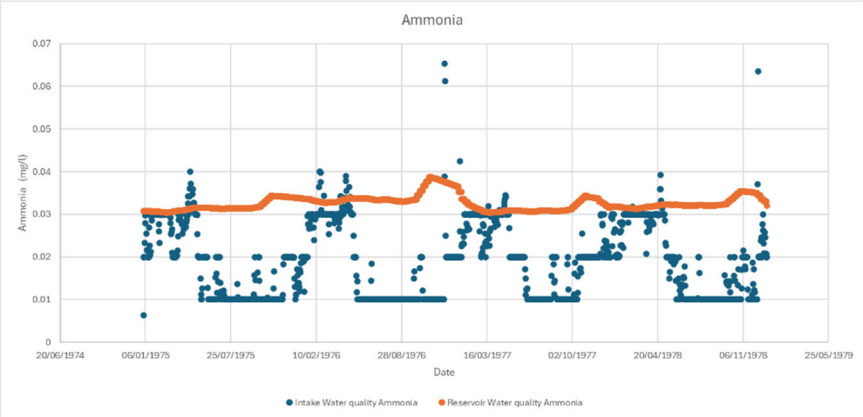
Appendix Figure C.1 – SESRO 4 year drought scenario model outputs

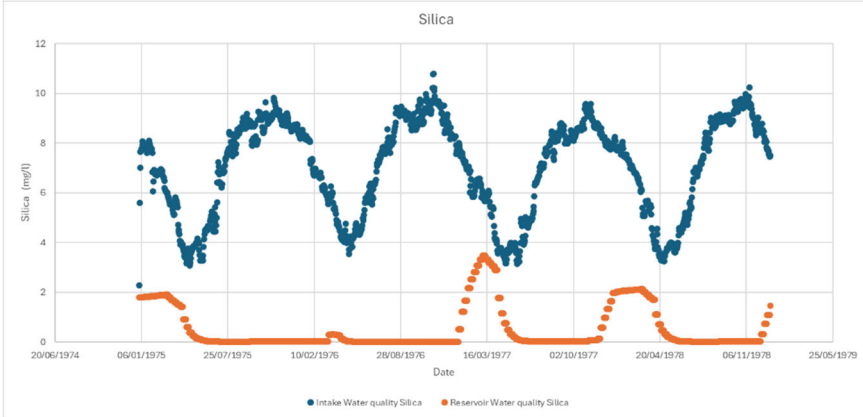


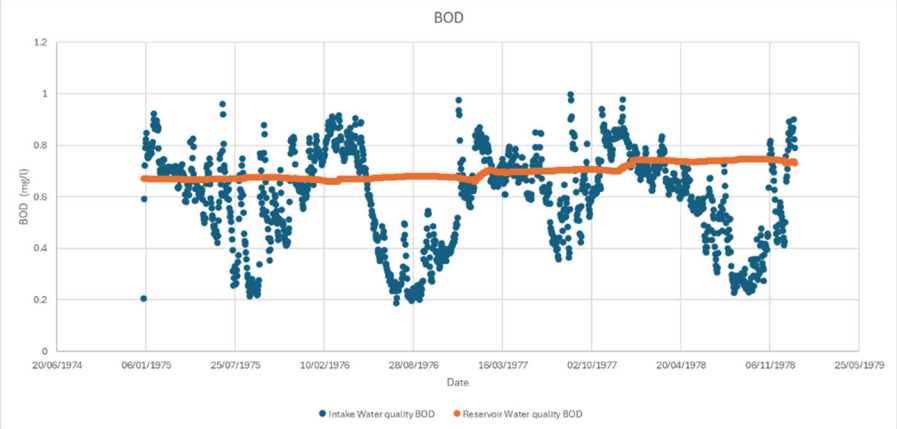


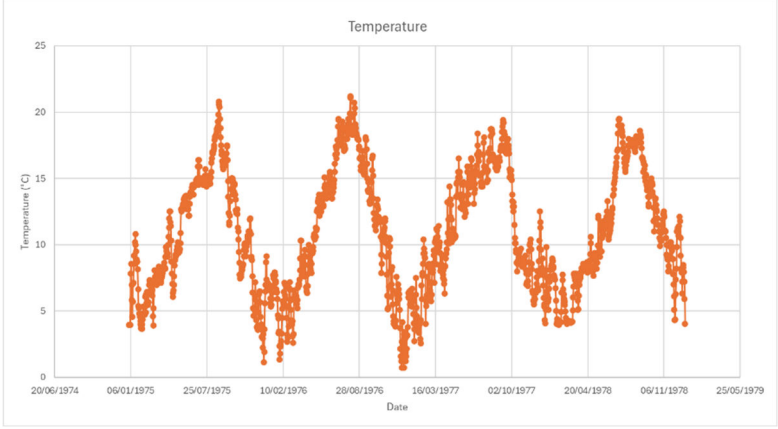


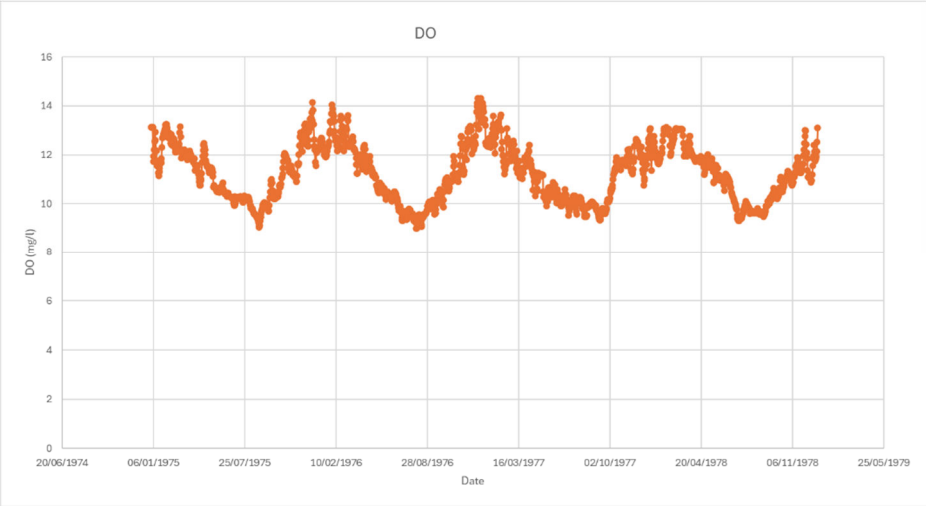



Ammonia
Ammonia (mg/l)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
20/06/1974
06/01/1975
25/07/1975
10/02/1976
28/08/1976
16/03/1977
02/10/1977
20/04/1978
06/11/1978
25/05/1979
Date
Intake Water quality Ammonia
Reservoir Water quality Ammonia

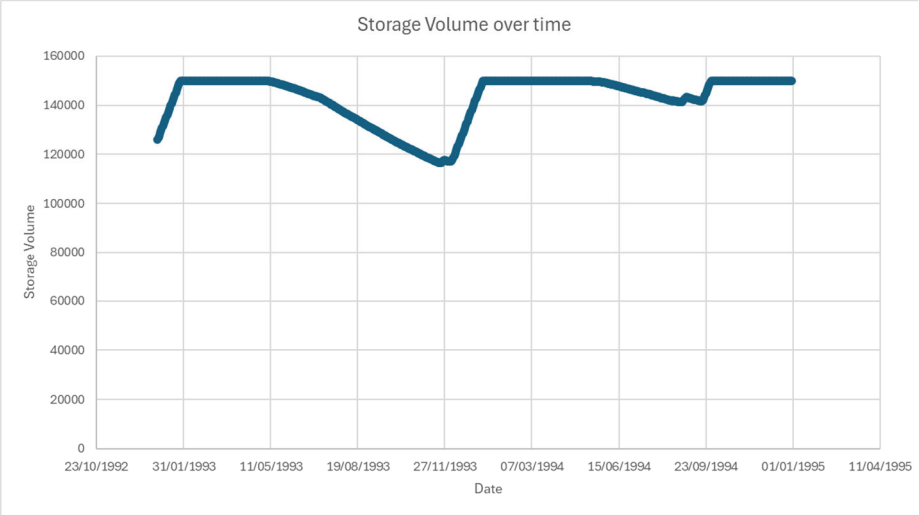

Silica
Silica (mg/l)
12
10
8
6
4
2
0
20/06/1974
06/01/1975
25/07/1975
10/02/1976
28/08/1976
16/03/1977
02/10/1977
20/04/1978
06/11/1978
25/05/1979
Date
Intake Water quality Silica
Reservoir Water quality Silica

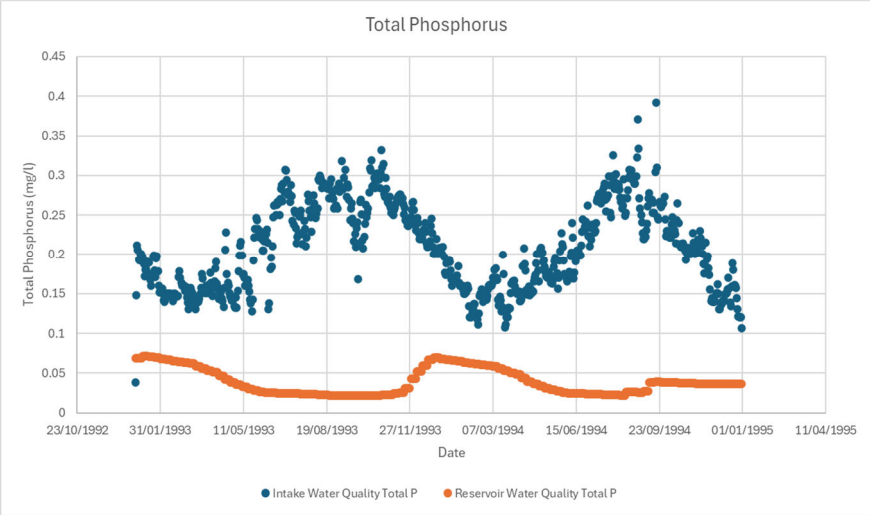

BOD
BOD (mg/l)
1.2
1
0.8
0.6
0.4
0.2
0
20/06/1974
06/01/1975
25/07/1975
10/02/1976
28/08/1976
16/03/1977
02/10/1977
20/04/1978
06/11/1978
25/05/1979
Date
Intake Water quality BOD
Reservoir Water quality BOD

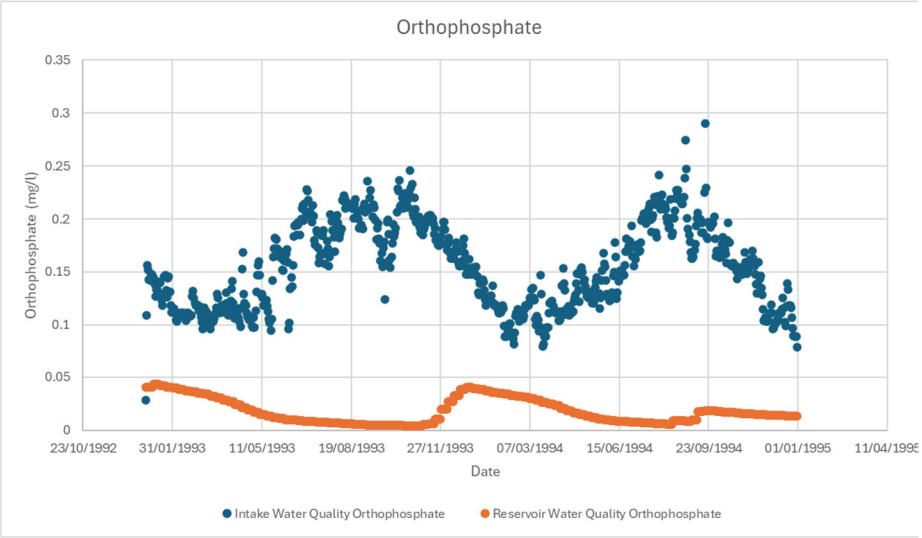

Temperature
Temperature (°C)
25
20
15
10
5
0
20/06/1974
06/01/1975
25/07/1975
10/02/1976
28/08/1976
16/03/1977
02/10/1977
20/04/1978
06/11/1978
25/05/1979
Date

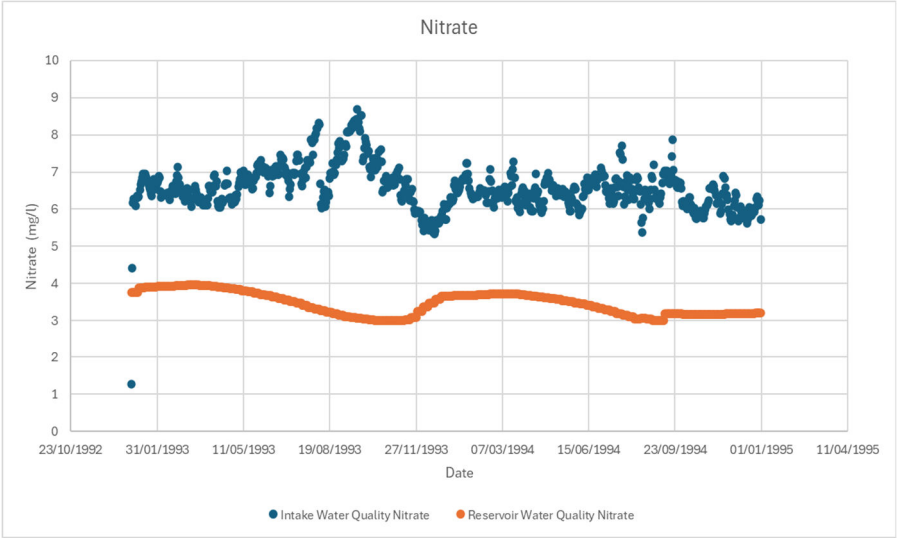


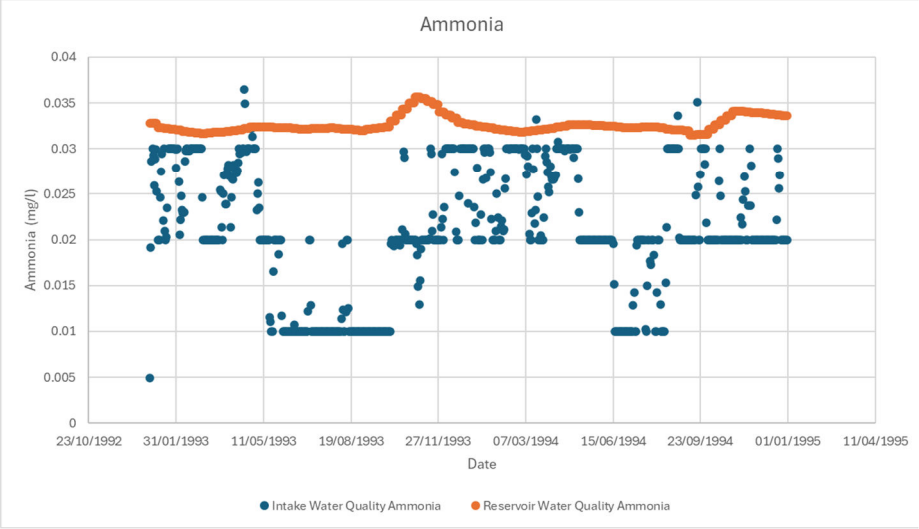
FigureApp 1 – SESRO 2 year drought scenario model outputs

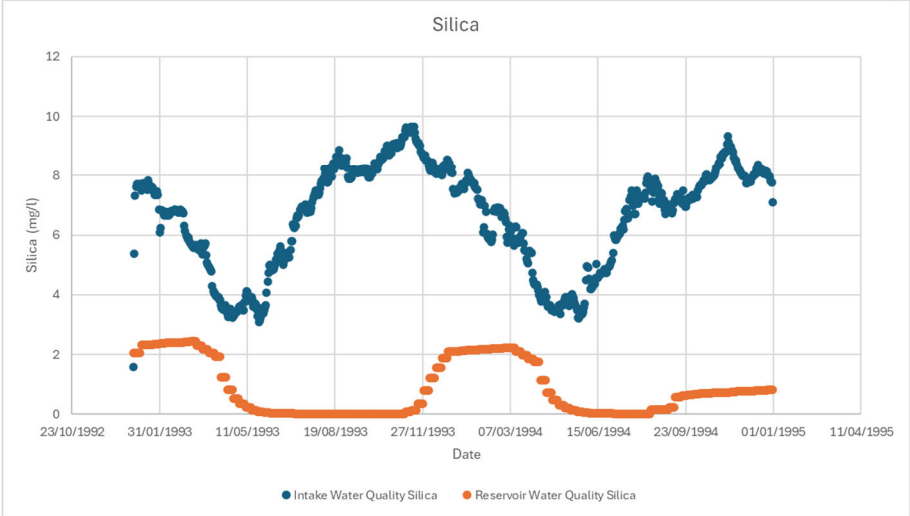


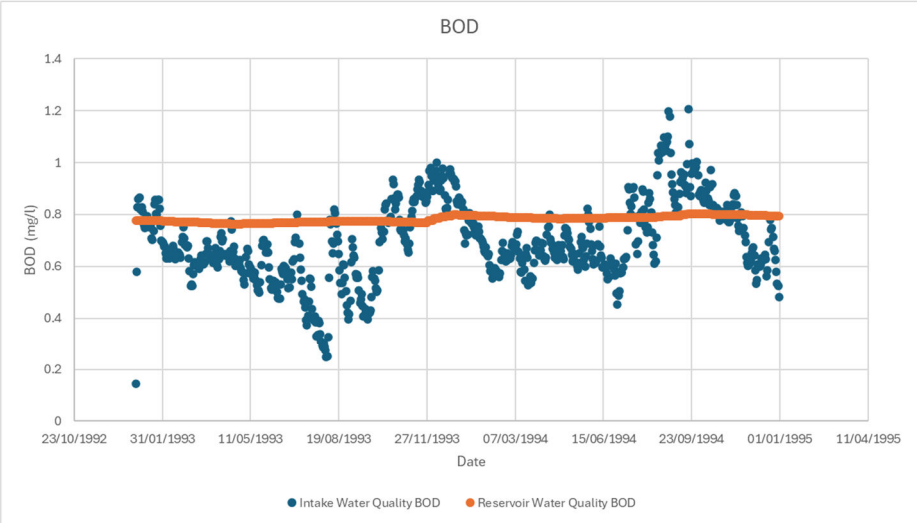


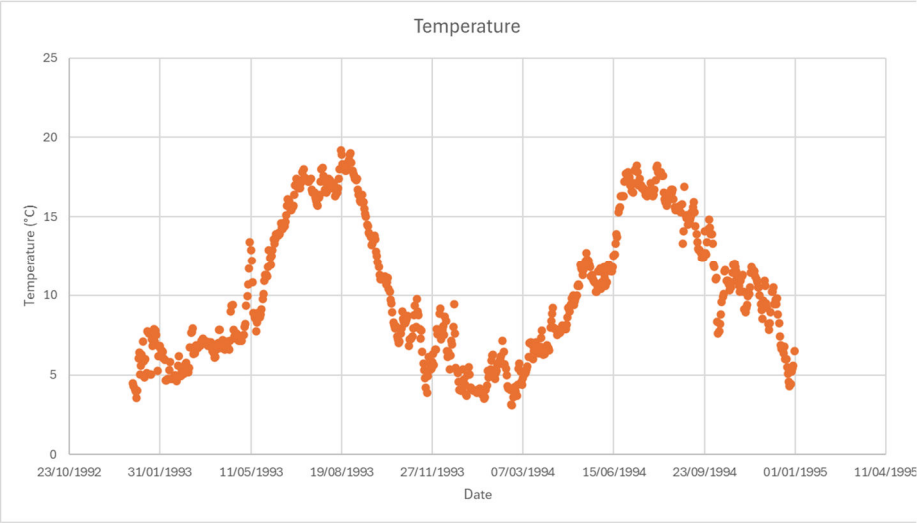

Orthophosphate
Orthophosphate (mg/l)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
23/10/1992
31/01/1993
11/05/1993
19/08/1993
27/11/1993
07/03/1994
15/06/1994
23/09/1994
01/01/1995
11/04/199
Date
Intake Water Quality Orthophosphate
Reservoir Water Quality Orthophosphate

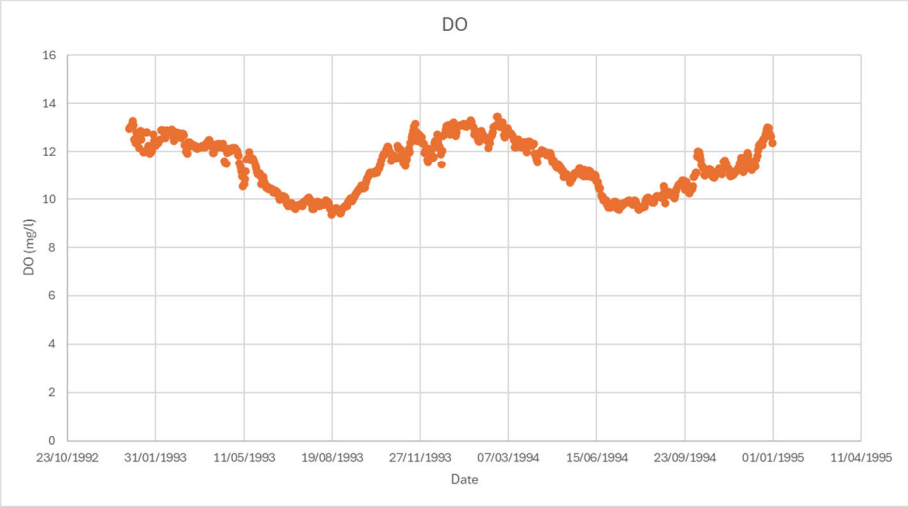

Nitrate
Nitrate (mg/l)
10
9
8
7
6
5
4
3
2
1
0
23/10/1992
31/01/1993
11/05/1993
19/08/1993
27/11/1993
07/03/1994
15/06/1994
23/09/1994
01/01/1995
11/04/1995
Date
Intake Water Quality Nitrate
Reservoir Water Quality Nitrate


Ammonia
Ammonia (mg/l)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
23/10/1992
31/01/1993
11/05/1993
19/08/1993
27/11/1993
07/03/1994
15/06/1994
23/09/1994
01/01/1995
11/04/1995
Date
Intake Water Quality Ammonia
Reservoir Water Quality Ammonia


Silica
Silica (mg/l)
12
10
8
6
4
2
0
23/10/1992
31/01/1993
11/05/1993
19/08/1993
27/11/1993
07/03/1994
15/06/1994
23/09/1994
01/01/1995
11/04/1995
Date
Intake Water Quality Silica
Reservoir Water Quality Silica


BOD
BOD (mg/l)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
23/10/1992
31/01/1993
11/05/1993
19/08/1993
27/11/1993
07/03/1994
15/06/1994
23/09/1994
01/01/1995
11/04/1995
Date
Intake Water Quality BOD
Reservoir Water Quality BOD


Temperature
Temperature (°C)
25
20
15
10
5
0
23/10/1992
31/01/1993
11/05/1993
19/08/1993
27/11/1993
07/03/1994
15/06/1994
23/09/1994
01/01/1995
11/04/1995
Date


DO
DO (mg/l)
16
14
12
10
8
6
4
2
0
23/10/1992
31/01/1993
11/05/1993
19/08/1993
27/11/1993
07/03/1994
15/06/1994
23/09/1994
01/01/1995
11/04/1995
Date

Thames Water

It's everyone's water

Affinity Water

Taking care of your water

WATER for LIFE

from Southern Water